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ROTUNDA

the magazine of the Royal Ontario Museum

BASEBALL

BEATING THE ODDS

JORDAN LIFE AT THE DAWN OF CIVILIZATION

GREAT DINOSAUR FINDS IN THE GOBI

BORNEO BIRDS

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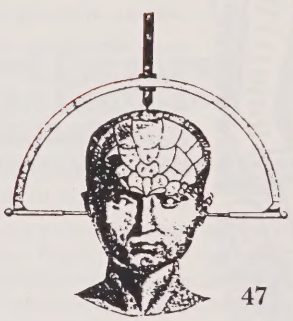
Volume 21, Number 4, Spring 1989
(Date of issue: February 1989)

COVER
Games about the game. These are some of the popular games that have been inspired by baseball. They and other baseball artifacts and memorabilia from the National Baseball Hall of Fame and Museum in Cooperstown, New York will be on display at the ROM as part of the exhibition *Let's Play Ball*, which opens 1 March. To find out about beating the odds, turn to page 25. *Photo by Richard Swiecki.*



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EDITOR'S NOTE

WELCOME TO THE NEW *Rotunda*. The magazine has been redesigned to make reading it a more pleasurable experience for you. Enjoy some casual browsing or find yourself thoroughly intrigued by the stories that you'll discover in each issue. We invite you to tell us what you think; letters are always appreciated. A readership survey, prepared for us by an independent company, was recently commissioned for the magazine. Questionnaires have been sent to a random selection of readers. Please complete and return them as soon as possible. Your comments will help us to produce an even better magazine.

* * *

Toronto's SkyDome will open this summer and the ROM's tribute to this much needed addition to the city's sports scene is *Let's Play Ball*, an exhibition about baseball. We are very honoured that one of North America's greatest baseball fans and natural history writers, Stephen Jay Gould, agreed to write our cover story. If there is one thing that amateurs of evolution and baseball have in common it is a love of statistics. So it made perfect sense to us when Gould suggested an article about streaks and slumps and the probability of their happening. We gather that it is more likely that an explanation for the extinction of dinosaurs will be found than an explanation for Joe DiMaggio's fifty-six-game hitting streak in 1941.

Talking about dinosaurs, Don Lessem gives a detailed account of the Canada-China Dinosaur Project, which is taking place in the Gobi Desert. The Gobi is proving to be extraordinarily rich in dinosaur fossils, including those of an uncommon number of carnivores.

From dinosaur bones we turn to Shelley Saunders' article about human bones and what they can reveal about life in prehistoric cultures. From bone studies of living people of all ages, in good and poor health, and from rich and poor societies, scientists have accumulated the necessary data to compare and analyse the skeletal remains of people who lived anywhere from hundreds to thousands of years ago. Such research is particularly valuable when little more than bones remain as evidence of a past settlement.

There is far more than bones at the 'Ain Ghazal site in Jordan. Dan Rahimi describes the captivating statues, figurines, and plastered skulls, as well as the interiors of the homes that belonged to the inhabitants of this site more than 9000 years ago. 'Ain Ghazal may have been the largest Neolithic village of the Middle East; the site is providing archaeologists with a treasure trove of information about life at the dawn of agrarian society.

And finally, the next time you wail that life is for the birds, take a moment to consider the feathered inhabitants of the Bornean rainforests. Stephen and Anne Nash studied the birds in the lush rainforest of Tanjung Puting, an environment that would appear to contain bountiful quantities of food in a very tolerable climate. Contrary to first impressions, however, life in the forest is not easy but the birds have evolved ingenious survival techniques.

We hope that you especially enjoy this issue of *Rotunda*.

Sandra Shaul

Sandra Shaul

PHOTOGRAPHY, GLORIA VARLEY

A glass of soy milk and dark delicious soy beans, served with a dish of soyadogs and tofu, show the amazing versatility of this legume.

Cinderella Soy

SOYBEANS DON'T HAVE A REPUTATION for glamour. They're unprepossessing seeds encased in fuzzy pods on squat bushlike plants that seldom grow taller than fifty or sixty centimetres. Yet appearances can be deceiving. The humble soybean is actually one of nature's most versatile vegetables, and has its own share of myth and magic besides.

Glycine max is native to China and was domesticated by 1000 B.C. It must have been held in high esteem from the earliest days if archaeological finds are to be believed. In a Han dynasty (202 B.C.–A.D. 220) tomb discovered in 1974, soybeans were among the foods set out for the deceased woman's use in the afterworld. Even recipes were included.

By about the 8th century, the plants had arrived in Japan, and they were soon dispersed throughout the Far East, a process aided, some say, by the spread of Buddhism with its emphasis on vegetarianism. Everywhere they were greeted with enthusiasm. That changed when soybeans arrived in Europe.

The first plants were probably brought back by Jesuit missionaries returning from China and, like the potato, they were treated as horticultural curiosities rather than as food. They went on exhibition in Paris's Jardin des Plantes in 1739 and turned up at London's Kew Gardens in 1790. Sometime in between they made their début in North America, possibly carried back from Paris by Benjamin Franklin; but even his interest failed to spark any keen concern with soybeans as human food. Fodder for animals, yes. Farmers quite early on reported that livestock of all kinds seemed to love the strange new beans and to thrive on them to boot. People lagged behind.

And still do. Even though the United States now produces some 75 per cent of the world's soybeans, and considerable quantities are grown in Canada and parts of Europe as well, most of the crop reaches North American and European stomachs by way of of animal "processors." We relish the meat raised on soy products while largely ignoring the valuable and much less expensive protein available from the bean itself.

Soybeans are nearly 40 per cent protein by weight, and this protein, unlike that in other legumes, has the necessary amino acids to be considered complete. They are also rich in B vitamins, iron, and potassi-

um. But there is a catch. These valuable nutrients can't be digested until they are hydrolyzed, that is, broken into digestible form by water, heat, or other agents. The so-called defensive secondary compounds that interfere with digestion—principally protease inhibitors and lectins—are so effective that animals fed raw soybeans will actually lose weight, because the effort to digest the indigestible takes more energy than it provides.

Once processed—boiling will do—soybeans become more manageable, although, like other beans, they can be accused of what 16th-century writers liked to call "windinesse." This socially unacceptable activity is caused by an assortment of oligosaccharides—short chains of linked sugars—which the body can't break down. Bacteria lurking in the lower intestine can, however, and they are to blame for the uncomfortable quantities of bloating gas produced in the process.

Although this may seem one of life's less critical health problems, for a time it was of great concern to both test pilots and astronauts. Intestinal gas expands as the pressure around it decreases, as happens in an unpressurized cockpit at high altitudes, and the resulting distention can cause considerable pain. There's also the problem of the gas's components. Hydrogen, methane, and hydrogen sulphide are potentially toxic. In the confines of a space capsule, it was thought these might build up to the point that astronauts would asphyxiate themselves. Recent research suggests that plant irradiation may be able to obviate the difficulty by weakening bonds between the sugar molecules; but other experts wonder if irradiation will cause problems of its own. Perhaps the best course is to introduce fibre-rich foods, including legumes, gradually to the diet. Within a few weeks, given this considerate treatment, human guts tend to accustom themselves and react in a more civilized manner.

Another way to make soy more

digestible and increase its available nutrients is to ingest it in one of its other edible forms. Health food stores and Asian markets abound in products including tofu, or soybean curd, either fresh or dried; tempeh, a fermented bean curd; soy milk; bean skin wrappers; bean pastes; soy flour; soy noodles; and fresh soy sprouts. And then there's the familiar soy sauce, in all its densities and colours, a condiment once so valued as an aphrodisiac that civil and military officers in 5th-century Japan happily accepted rations of it as part of their salary.

Tofu, or doufu, seems to have been discovered in China between A.D. 200 and 900. To make it, dry beans are soaked and then crushed and boiled. The resulting soy milk is separated from the pulp (which can be used for other purposes), and a coagulant is added so that it separates into curds and whey. Fresh curds are poured into moulds and left to settle for a few hours. After that, the cakes are soaked in cold water to firm them still more and keep them fresh.

Tofu is highly perishable. In the Far East it's usually made and sold on the same day. In North America it's more often processed a step further and packed in vacuum-sealed containers (with water) or in Tetrapaks, which can keep it fresh under refrigeration for a considerable time. Coarser regular sorts of tofu may have to be pressed as well as rinsed and drained before use—the recipe will specify—while one Japanese version, silken tofu, is so like a delicate baked custard in texture that it is never pressed. For most people, bean curd is as easily digested as cow's milk (and for those with lactose intolerance, far more easily).

Tofu often appears in other forms as well, many of them the butt of jokes. Soylami certainly sounds funny, but the business of teasing bean curd to resemble something it's not is by no means only a modern foible. Buddhist vegetarians started the trend more than a thousand years ago when

they busily turned doufu into imitation meat, poultry, and fish in their temple kitchens. Even if you quail at the thought of soyadogs and tofu ice cream, you may be eating more soy than you think. It's an ingredient in an amazing variety of canned and packaged goods including instant soups, prepared spaghettis and raviolis, coffee whiteners, and "bacon bits." Mind you, it doesn't always appear under its own name. Look for hydrolyzed plant protein or TVP, textured vegetable protein, amidst the label's fine print.

The uses of *Glycine max* don't stop at the kitchen door. Old custom held that soy would do as well as any bean to vanquish ghosts. Simply hold one in your mouth, then spit it at the offending phantom. In more recent times, parts of the soy plant have been used for more practical purposes to produce bottle caps, dusting powder, pencils, diesel fuel, cosmetics, firefighting foam, cement, wallboard, paints and varnishes, linoleum, and nitroglycerin. Automotive pioneer Henry Ford was a sturdy proponent of the bean's usefulness and loved to pose problems for his engineers to solve with soy. They did this so successfully that at times during the '30s every Ford car carried at least a kilo of soy beans in anything from window frames to gearshift knobs and accelerator pedals. Other engineers, when metal was short during World War II, experimented with a soy fibreboard for car licence plates. The plates stood up to the rigours of traffic quite well, until a goat put an end to the project by eating one.

At least one mystery about the soy bean remains unsolved. Why, given its sterling character, don't more of us enjoy it? The answer probably lies in some half-buried remembrance of times past, when beans of any sort bore the stigma of being food for those who couldn't afford any better. Few of us mention baked beans in the same breath with filet mignon. Fewer still fret about which wine complements soybean soufflé. The poor soybean is seen as a low-status vegetable worth-

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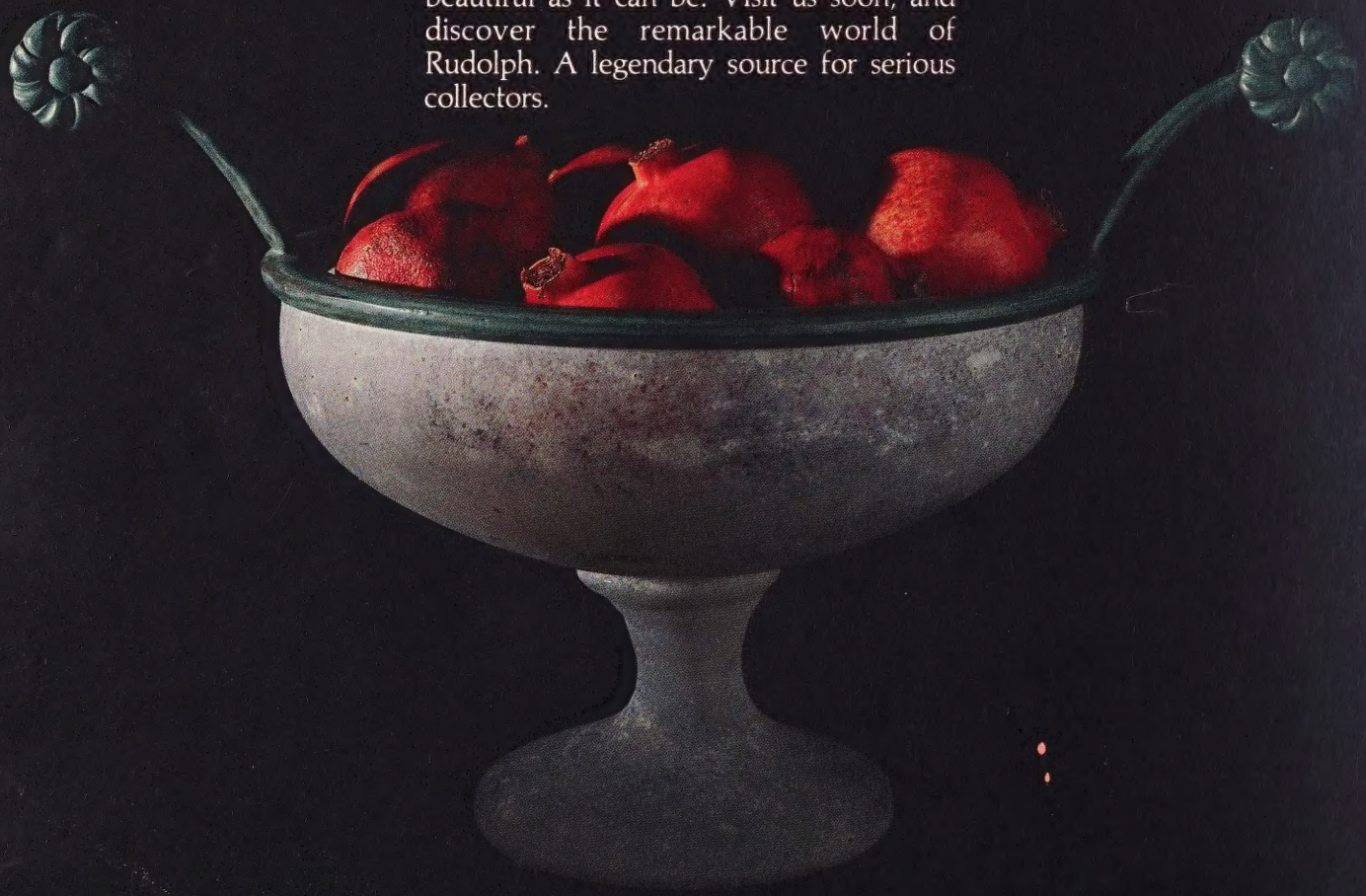

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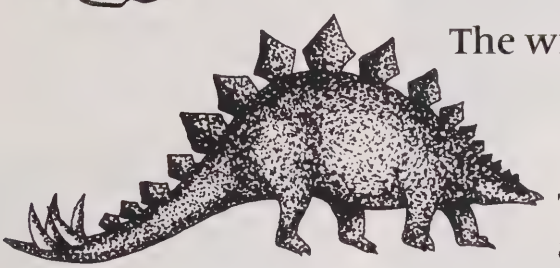

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while only as livestock feed or a stretcher for meat. We don't know what we're missing.

Silken Stir Fry

Ingredients

The name indicates the type of Japanese tofu—labelled silken/firm—that's best to use, but you can use regular tofu instead.

- about 283 gm fresh tofu
- soy sauce
- about 45 mL of peanut oil
- 5 to 10 mL minced fresh ginger root
- a few drops of chili oil, to taste
- 1 small yellow summer squash, sliced diagonally
- 1 sweet red pepper, in 2.5 cm squares
- 9 or 10 green onions (white and light green parts), sliced diagonally
- 3 medium button mushrooms, cut in eighths
- 1 bunch bok choy, stalks cut in diagonal slices, leaves torn into medium-size pieces

Method

- Rinse tofu and cut into about 1 cm cubes. Sprinkle with soy sauce and refrigerate, covered, until ready to use, or at least 1 hour. Sprinkle squash slices with salt and leave to drain for 30 minutes, then dry well.
- Heat oil in wok or sauté pan and fry ginger over gentle heat for about 5 minutes. Add chili oil and increase heat to moderately high. Add bok choy stalks and stir for 1 minute. Add red pepper and stir for 1 minute more, adjusting heat when necessary, then green onion (2 minutes), squash slices and mushrooms (1 minute), and bok choy leaves (1 minute). Sprinkle with a little soy sauce and 15 mL or so of water and arrange tofu cubes on top. Cover, turn heat to low, and steam for about 4 minutes.
- Serve immediately with boiled rice. (Handle carefully so the tofu doesn't break up.) This is enough for supper for two, or for four if it's part of an Asian-style meal.

Gloria Varley

The European and Canadian collections glitter with silver and gold

Major collection of English miniature silver presented to Museum

A COLLECTION OF MINIATURE SILVER household items, most of them English, was recently presented to the ROM through the generosity of an anonymous donor and the Canadian Cultural Property Review Board. The collection comprises 282 pieces, exclusive of covers and individual items in cruet sets, and has been carefully acquired over a period of twenty-two years. The pieces range from a sweetmeat dish or "saucer" c. 1640 to a Regency-style tea set with London hallmarks for 1984. Experts in England and the United States consider ours to be the best collection of English silver miniatures in existence. Antique English miniatures are quite rare and therefore are highly valued.

Miniature silver household articles were first produced in quantity in the 1650s, mainly in the Netherlands. By the 1680s the taste for these toys, as they were called, had spread to England through dynastic and trade connections.

A growth in the production of silver objects in the 1600s resulted from the increased quantity of silver available from the mines of Central and South America. The objects themselves included luxury furniture, such as tables, thrones, and looking glass frames, as well as large vases and candlestands for palaces. While many of the miniatures undoubtedly served as special playthings for children of the wealthy, they were also collected by women, who used them to furnish elaborate doll's houses.

PHOTOGRAPHY: ROM

Top: A unique, gold freedom box, presented by the City of Dublin to Admiral Saunders in 1759, now belongs to the ROM. Left to right: A sterling silver basket, tea pot, and mug are just three of the miniatures presented to the ROM.

The miniatures reflect the great interest in domestic life that began in Holland in the late 16th century. In fact, the Dutch seemed almost to elevate domesticity to an art form, as is amply evident in the popular moralistic verses of Jakob "Father" Cats (1577-1660), which were also translated into English. Today, the silver miniatures are probably best known through the doll's houses preserved at the Rijksmuseum, Amsterdam; the Frans Hals Museum, Haarlem; Uppark, a National Trust House at South Harting, Sussex; and Nostell Priory in Yorkshire.

Our new gift will allow Museum visitors to study the important early period of English production, c. 1680-1750, through a superb range of examples by craftsmen who specialized in "toys," such as George Manjoy (working c.1685-1720), David Clayton (working 1697-c.1730/1735), his son John Clayton (working 1736-c.1737), and John Hugh Le Sage (producing miniatures 1739-c.1750). In addition to a good representative selection of later examples, there are also several very rare Irish and Scottish miniatures. Certain pieces in the

collection, such as a pair of sconces and several sets of fireplace equipment, are especially valuable additions to the ROM's silver collection, since full-size versions are costly, besides being extremely difficult to find. A permanent display of this wonderful gift is being planned for the new European Galleries scheduled to open in the fall of 1989.

PETER KAELLGREN
European Department

Gold freedom box acquired by the Museum

A UNIQUE, GOLD FREEDOM BOX, BY Samuel Teare of Dublin, c.1759-60, was purchased by the Canadian Decorative Arts Department. Once again, a grant from the Canadian Cultural Property Review Board, as well as aid from the Costello Trust and a private donor made the purchase possible.

There is a story behind the box. Admiral Sir Charles Saunders, naval commander at the Siege of Quebec in 1759, started the voyage back to Britain with his fleet in October of that year. The squadron arrived in Cork, Ireland, in December, and then Saunders travelled on to Dublin, where he was greeted with great ceremony as the co-victor (with Wolfe) of Quebec. On 18 December 1759, the Dublin City Council presented Saunders with this gold box, which would have originally contained a folded certificate granting him honorary citizenship ("Freedom of the City").

The box is rococo in style, engraved with the coat-of-arms of Saunders on the lid and with the coat-of-arms of the City of Dublin on the base. Apart from the Saunders and Quebec connection, the box is a special addition to our collections because gold boxes are rare; most were made of silver. Furthermore, extremely few known boxes are of Irish origin.

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Digging For Dinosaurs In China

Canadian and Chinese palaeontologists are discovering new species and shedding new light on the mysterious era of the dinosaurs

Don Lessem

The Gobi Desert is brutally hot in the summer. By midday the temperature rises to 60°C. Sandstorms whip suddenly off the vast horizon, smothering everything in clouds of red grit that sweep as far south as Beijing. The nomads repair to the shade of their yurts; the Chinese and Canadian palaeontologists keep digging.

On such a day last July, during the third year of the joint Chinese-Canadian expedition to the fossil-rich deserts of northern China, Dong Zhiming was on hands and knees, scraping at the white-crusted dirt of the Gobi, when he suddenly came upon a flat, blackened palm-sized lump. Brushing clean the object with his thick fingers, the voluble Chinese palaeontologist chortled with pleasure.

Gingerly holding his find, Dong rushed across the endless plain to show it to his Canadian project co-leader, Philip Currie, assistant director of the Tyrrell Museum in Drumheller. Currie was hunched over another mound of scattered pebbles and bone fragments. A gentle, undemonstrative man, Currie nonetheless laughed with open glee as he admired Dong's discovery.

In the harsh light of the sun, there was no mistaking his find, nor its origin: a crushed tin, etched with the outline of an American family in its Model T convertible. Below the jalopy, bold letters proclaimed: SPIRITS.

This particular piece of American garbage was a special delight to the expedition members. It offered tangible proof that they had read and resolved dated and contradictory maps and diaries so well that they had found their way to the precise locale of the Iren Dabasu (Shining Telegraph Station) quarry—the site of the first dinosaur bones ever found in Mongolia. It was just here on 27 April 1922 that American Museum palaeontologist Walter Granger walked over to his colleague, eyes shining, his pocket full of fossil fragments, and announced, "Well, Roy, we've done it. The stuff is here."

Roy was Roy Chapman Andrews, chief of the fossil-finders, and leader of the American Museum Central Asiatic Expeditions of 1921-1930. Those forays by motorcar, yak, and camel were (and still are) the most ambitious, expensive, and highly publicized of all dinosaur hunts ever undertaken—that is, until the anticipated $15-million Canada-China Dinosaur Project is completed in 1989.

PHOTOGRAPHY: DON LESSEM

Dong Zhiming and Philip Currie, co-leaders of the Canada-China Dinosaur Project, examine a fossil that had just been found in the Iren Dabasu (Shining Telegraph Station) quarry.

Andrews didn't find what he was looking for in the Gobi: an Asian ancestor to modern man. But what he did find has inspired several international quests, the Dinosaur Project latest among them. Each has come away with fresh evidence of a prolific Asian dinosaur fauna from the late Cretaceous (80-65 million years ago), the final 15 million years of a worldwide reign ten times as long.

Dinosaur Project fieldwork is far from complete. But already project diggers have unearthed a partly familiar, partly bizarre array of dinosaur fauna. The remains

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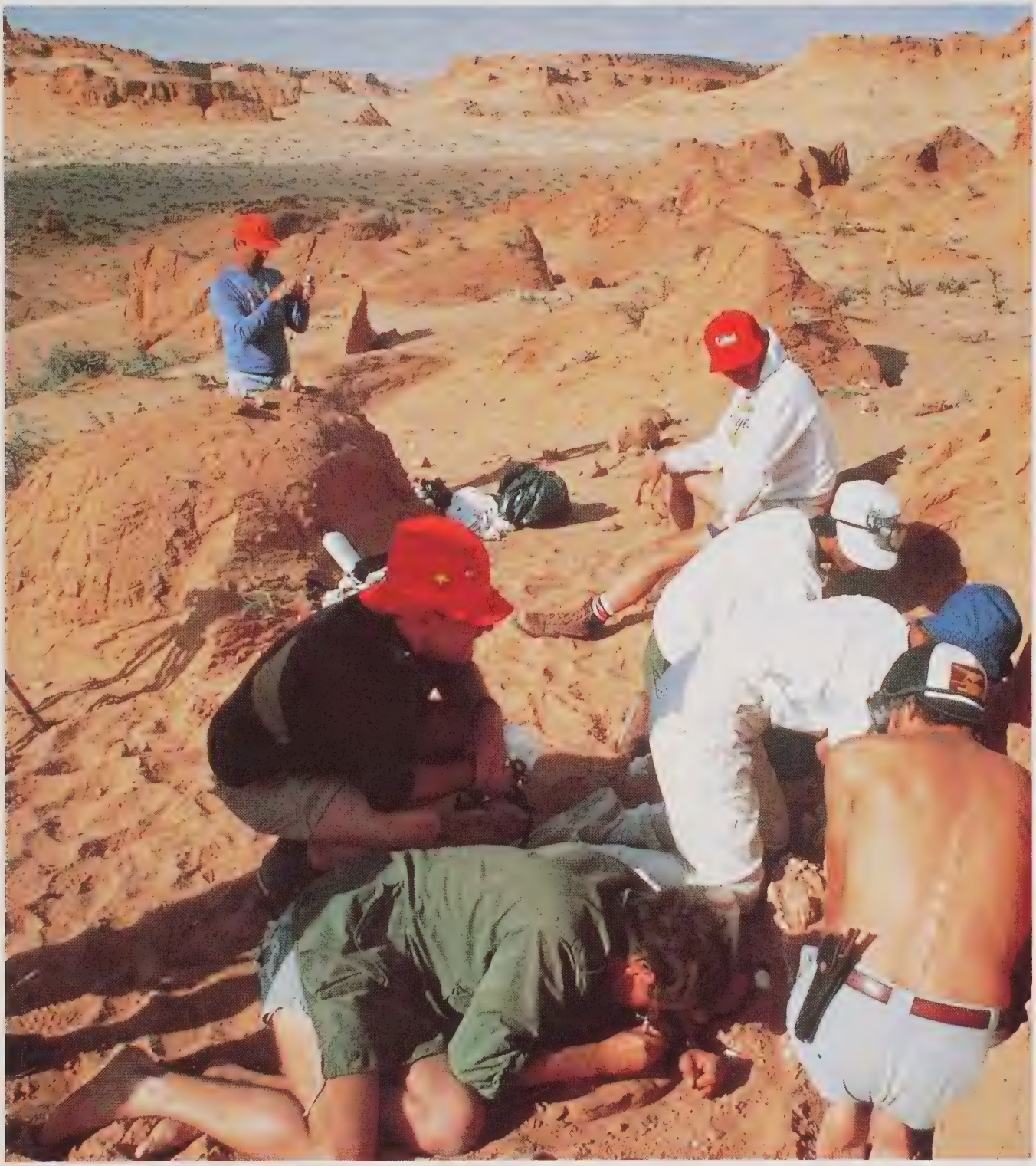
Boston writer Don Lessem is at work on a book about dinosaur fieldwork for Contemporary Books.



PHOTOGRAPHY, THE EX TERRA FOUNDATION

Chinese and Canadian scientists worked on a site near Bayn Mandahu, Inner Mongolia, which is considered to be a far larger and more important site than the celebrated Flaming Cliffs. Previous expeditions may have missed this site because they had no ground or aerial surveys, and the dune sand was probably too soft for their vehicles to climb.

range from whole articulated skeletons to tiny teeth and knuckle fragments, from vast beds of monstrous and scattered limbs to a tragic huddle of suffocated babies and brittle shards of a half-dozen sorts of dinosaur eggs.

By their excavations, project scientists have obtained fresh insight into questions of dinosaur physiology, environment, and behaviour. And they have cast further light on the fundamental question that they sought to answer—how closely did the dinosaurs of Asia resemble their North American counterparts in an era when the continents were often joined? The Canadian-Chinese team has also managed along the way to prove its prede-

Off the natural history trails, R. C. Andrews was a polo-playing society gadabout; on them he was a devoted fossil collector. He did not achieve his goal of finding an Asian ancestor to modern man, but he did find a lavish assortment of remains from stone-age humans to the largest mammal to walk the Earth. And he found dinosaurs.

cessors, beginning with Andrews, and even its own members wrong.

* * *

HIS REVOLVER EVER AT HIS SIDE to ward off brigands, a hat perched jauntily on his balding head as he sped across the rocky Gobi scrubland, R. C. Andrews was Indiana Jones incarnate. (Indeed he is the reputed inspiration for Spielberg's swashbuckling anthropologist).

Andrews was probably not such a romantic figure to the Mongolians, whose fossils he seized and whom he called an "unwashed" people. From a yurt colony close by Bayn Dzak, the spectacular Flaming Cliffs where Andrews made his greatest finds, one octogenarian Mongolian woman described Andrews and his companions to me as "frightening, hairy-armed men in noisy cars."

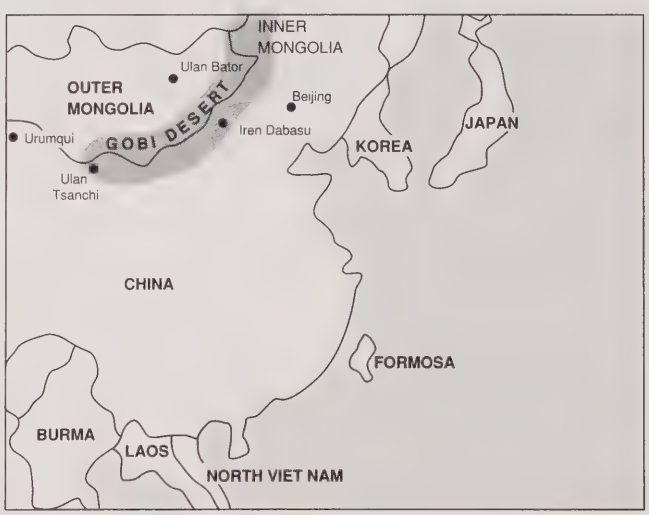
Off the natural history trails, Andrews was a polo-playing society gadabout. But on them he was a devoted fossil collector, although a jolly prankster too. (He buried bits of metal and eggs that he painted in order to confuse his fellow palaeontologists.)Instead of an Asian ancestor to modern man Andrews found a lavish assortment of remains from stone-age humans, from tiny mammals whose ancestors dated back to the age of dinosaurs, and from post-dinosaurian giant mammals like the six-metre high *Baluchitherium* (now known to be synonymous with *Indricatherium*, an earlier find in India), the largest mammal to walk the Earth. Andrews also found the largest mammalian predator, dubbed *Andrewsarchus*.

And he found dinosaurs. Lots of dinosaurs. Most common was a small, horned vegetarian. This creature appeared to be ancestral to the ceratopsians, horned dinosaurs, including *Triceratops*, that carpeted western Canada like ants at a picnic just before the dinosaurs' demise about 65 million years ago. These new forms Andrews called, again as one might expect, *Protoceratops andrewsii*. He saw them, like the tiny mammal skulls, as evidence that Central Asia had been a source for the species that would evolve into the later life-forms in North America.

More than two hundred kilometres to the northwest of the Iren Dabasu wasteland, in the red sandstone canyons of Outer Mongolia (now within the Soviet-linked Mongolian People's Republic), Andrews made his most spectacular finds: a strange, toothless predator that his mentor and museum boss Henry Fairfield Osborne called *Oviraptor* (egg thief), and just below its gummy bite, a clutch of crushed eggs, oblong and flattened, each more than fifteen centimetres in length. Andrews speculated that these and several other clutches found nearby, twenty-three eggs in all, were dinosaur eggs, the first ever found. In fact, French researchers had found egg-shell on the Riviera years before, and Andrews's team had done the same at Iren Dabasu just a year earlier, but as there were no dinosaur fossils near either find, they weren't correctly identified. Still, it was the egg-find above all that rewarded Andrews with celebrity beyond even his fondest expectations. But when he auctioned one egg off for $5000 to benefit further Central Asian expeditions, he nearly put an end to international exploration of Gobi dinosaurs. If one egg was worth that much, the Mongolians figured, why let Andrews take more of their valuable booty?

The Great Depression compounded Andrews's diplomatic problems and he gave up the Gobi, reluctantly. "We left the Flaming Cliffs with regret. They had given us more than we dared to hope from the entire Gobi... I would never see them again."

But where Andrews's expeditions ended, others followed. Sven Hedin, Swedish explorer, geographer, and supporter of Aryan racism, undertook his own survey of Central Asia in 1927, with German support. Though Hedin's health failed and an Asian ancestor to modern man eluded him, the joint Swedish-Chinese investigations stretched into the 1930s and turned up more dinosaurs, among them a new sauropod, *Tienshanosaurus*, a bulky plant-eater related to the familiar brontosaur. One site is noted by the Sino-Swedish team as a similar outcrop of sandstone formations to the Flaming Cliffs, but three hundred kilometres to the southeast. In Hedin's maps the area was named Ulan Tsanchi (for its landmark red tower).



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Roy Chapman Andrews, whose team found the first dinosaur bones in Mongolia, is the reputed inspiration for Indiana Jones. Ironically, the aim of his expedition was not to discover dinosaurs but rather an ancestor to modern man. Andrews is pictured here with some American visitors.

After the war, from 1946 to 1969, Soviet palaeontologists carried out extensive digs in the Gobi, unearthing several well-preserved large dinosaur skeletons. Among them was a giant predator, *Tarbosaurus*, astonishingly like the North American behemoth *Tyrannosaurus rex*, and one of the largest of duckbills, *Saurolophus*, which also had close counterparts known from North America. Both finds were striking evidence that considerable interchange between Asian and American dinosaurs occurred in the late Cretaceous.

But the promising work was not attempted until Chinese and Soviet palaeontologists came back to the Gobi

The Polish expedition was hugely successful. Its most spectacular find still ranks as the most dramatic of all dinosaur finds. Thirty kilometres west of the Flaming Cliffs, the Poles uncovered two dinosaur skeletons beautifully preserved as they died, locked in a vicious struggle.

in 1959 and 1960, retracing much of Andrews's route. Zheng Jiajian, now senior administrator for the twenty-man Chinese delegation to the Dinosaur Project, was a young mammal researcher on the Sino-Soviet Gobi expedition. At Iren Dabasu they found hadrosaurs (duckbill dinosaurs) and small theropods (carnivorous dinosaurs). Further to the west in Inner Mongolia they came upon iguanodonts (hadrosaur ancestors) from the lower Cretaceous, more carnivorous dinosaurs, and a complete skeleton of an ankylosaur —armoured, club-tailed dinosaurs—six metres long and weighing five thousand kilograms.

The Sino-Soviet expedition was far from a rousing success. No new species were found at Andrews's sites. Like Hedin's team, a Sino-Soviet party ventured to Ulan Tsanchi, and likewise came away empty-handed. Records of localities and associated finds were not well kept. Methods were questionable as well. Whereas most palaeontologists work their quarries with small hand tools, carefully exposing the delicate bone, the Soviets bulldozed mounds of Gobi soil in search of treasures, fragmenting many remains in the process.

Under the autocratic rule of Soviet palaeontologist A. K. Rozhdestvensky, as Zheng recalls with a quietly rueful smile, "there were many conflicts. The Russians were our big brothers. They always gave us orders, no discussion. We were not strong enough to argue." In the midst of the second field-season, the project dissolved in acrimony, reflecting a broader breakdown in Soviet-Chinese relations. The Soviets took the vehicles, food, and fossils back to the USSR and left the Chinese to find their own way out of the Gobi.

Not surprisingly, politics and bureaucratic complications aside, the Chinese have been wary of sponsoring international fossil digs in the Gobi ever since. Except for the disruption of their own palaeontological projects during the Cultural Revolution, the Chinese have turned their attention elsewhere in a land uniquely blessed with rich fossil finds from nearly every era of dinosaur evolution. As Dong wrote proudly of Chinese dinosaurs, "China is the only country in the world where enough of the pages have been preserved intact to show what was happening throughout their history."

But across the border, in Outer Mongolia, the explorer's gauntlet thrown down by Andrews was picked up by a young Polish scientist, Zofia Kielan-Jaworowska. Interested in Cretaceous mammals, the headstrong director of the Palaeozoological Institute of the Polish Academy of Sciences organized four of her own expeditions to the Gobi between 1963 and 1971, with Mongolian cooperation.

Kielan-Jaworowska ran a "tough, military-efficient camp," according to Tomasz Jerzykiewicz, a young sedimentologist on the 1971 expedition, now acting in the same capacity for the Dinosaur Project. When her Polish and Mongolian driver-guides succumbed to too much *bozhomoika* (Russian moonshine) Kielan-Jaworowska took the wheel of the huge Polish all-terrain vehicle herself.

The Polish expedition was hugely successful. Its most spectacular find still ranks as the most dramatic of all dinosaur fossil finds. Thirty kilometres west of the Flaming Cliffs, the Poles uncovered two dinosaur skeletons beautifully preserved as they died, locked in a vicious struggle. A swift small predator, *Velociraptor,* holds the skull of a *Protoceratops andrewsii* between its forelimbs, hind claws locked in its victim's abdomen. Since Polish sedimentologists, and the Russians before them, read the Djadokhta Formation as a lake-shore environment, Kielan-Jaworowska speculated that the opponents "died as they fought... embedded in quicksand."

To drama Kielan-Jaroworska added controversy. Her team collected 150 mammal skulls, from the Djadokhta Formation of the Flaming Cliffs and from younger sediments as well. The peculiarity of these specimens, together with other contemporary discoveries of mammals in North America, showed that Andrews had been wrong about placental mammals originating in the Gobi.

In the Nemegt Valley to the southwest of the Gobi, Kielan-Jaworowksa found a third, even younger formation, and evidence that Andrews may have been off on his theories of dinosaur origins as well. While only fragments of sauropods had been known from the Gobi, and none from the northern United States and Canada in the late Cretaceous, the Poles found a fine skull of a new sauropod. And stranger still were the huge forelimbs and shoulder girdle of a puzzling giant that Kielan-Jaworowska named *Deinocheirus.* Unlike the tyrannosaur whose arms are puny, this carnivore of similar size had Olympian forelimbs, 2.5 metres long, fixed with 30-centimetre claws. Nothing remotely akin to *Deinocheirus* has ever been discovered in North America. Nor are the pachycephalosaurs (dome-headed dinosaurs) of North America much like the three new kinds of dome-heads the Poles turned up. Where North America was rich in ceratopsians and hadrosaurs, Asia had none of the horned dinosaurs and few of the duck bills.

Kielan-Jaworowska concluded, largely on mammalian evidence, that there was no large land ridge between Asia and North America permitting animal interchange

PHOTOGRAPHY: THE EX TERRA FOUNDATION

The most spectacular find of the Canadian-Chinese expedition was the mass burial of five baby pinacosaurs, a form of ankylosaur (armoured dinosaurs), huddled together as they had died, pinned beneath a collapsing sand dune. The babies, which were the size of small sheep, were too young to have developed the bony armour and tail clubs characteristic of their parents.

in the late Cretaceous. What few animals made it across the continents did so by fluke, perhaps fording or rafting shallow marine straits. As for dinosaurs, she found the evidence of interchange so sketchy and confusing that she would venture no conclusions.

Her puzzlement notwithstanding, Kielan-Jaworowska had made discoveries so spectacular that in 1971 the Soviets promptly put an end to further work by the Poles and reinstituted their own investigations.

Though their crews were not in the field in 1988, Soviet-Mongolian dinosaur workers have consistently worked the Gobi for more than a decade. They've un-

Fieldwork by the Canadian-Chinese team was performed in the brutal heat on stubbornly hard red rock in Xinjiang. Jackhammers and even dynamite were needed to remove the overburden. The herculean efforts were rewarded with the discovery of the largest sauropod ever found in Asia.

covered dozens of sauropod and *Protoceratops'* eggs, nearly complete skeletons of tarbosaurs, a baby hadrosaur, and *Protoceratops'* of several sizes—far more riches than they've had time and resources to prepare and study. They have described several new species of dinosaurs, theropod predators in particular. Though rare elsewhere, carnivorous dinosaurs are strangely abundant in the Outer Mongolian Gobi—twenty of the world's fifty known forms were discovered there. Many of those specimens that have been worked on are now on display in a handsome dinosaur hall in the musty State Museum in Ulan Bator, among them Kielan-Jaworowska's fighting dinosaurs and the huge meat hooks of *Deinocheirus*.

It was these exotic Mongolian meat-eaters that Phil Currie, the world authority on theropod dinosaur anatomy, said he was most eager to study when asked by a young Tyrrell Museum researcher, Brian Noble, five years ago. Noble pursued in vain a Soviet cooperative project that would allow Currie to go to Mongolia, where only one western palaeontologist (then Columbia University graduate student Paul Sereno in 1984) had been in decades.

But Noble's non-profit Ex Terra Foundation did land Currie's second choice, Inner Mongolia. The Chinese, lately involved in many international scholarly exchanges, had received many offers for joint dinosaur study, American, Japanese, and French among them. But Noble's offer proved particularly appealing, because it was unique in its proposal to arrange visits by Chinese palaeontologists to Canada to study North American dinosaur fauna.

Though Currie and Canadian co-leader Dale Russell had intended to study Mongolian fauna, the Chinese opted to expand the search to the Jurassic (190 to 135 million years ago) of far western Xinjiang, an area they had lately worked and one of particular interest to Dong Zhiming, whose area of expertise is Jurassic sauropods.

Currie, Russell, and Dong performed preliminary site explorations in 1986, and the team's most significant finds of the year came not from China, but Alberta, where Chinese technician Tan Zhilu came upon the jaw of a rare small theropod, *Troodon*.

The first full season of fieldwork was performed in the brutal heat on stubbornly hard red rock in Xinjiang, not far from Urumqi, the most inland city on Earth, and Chinese missile-testing installations. The rock proved so resistant to excavations that jackhammers, even dynamite, were used to remove the overburden.

The herculean efforts were well rewarded. The finds included a *Mamenchisaurus*, the largest sauropod ever found in Asia, a 27.4-metre-long plant eater with what Russell calls "a strange pipe-cleaner neck." With vertebrae about 1.5 metres long, thinner than a poster tube, and rigidly linked, the neck was, according to Russell, "half as big as the whole animal," which is double the relative size of most sauropod necks.

Two large new-to-science theropods were partially dislodged, one of them the first single-crested carnivore found by the Chinese in a previous expedition and still not fully removed from the unforgiving stone. While this sauropod has no counterpart in North America, the two carnivores in Currie's view "are clearly allosaurids" (relatives of the allosaur common in western North America 160 million years ago). They are too similar to have arisen independently. Russell, a reticent man of abundant and often controversial theories, had speculated that a worldwide mixing of dinosaur faunas had taken place in the Jurassic, but the conflicting answers his own find produced left him "very surprised. It gave me terrible feelings of unease."

The skull of the second large carnivore at the Xinjiang site was found just ninety minutes after Currie, Russell, and Dong set out on a six-thousand-kilometre jeep trek to scout sites in Inner Mongolia for the 1988 dig sites. It was an arduous but highly rewarding journey, for as the group wended east, they found dinosaur bones scattered by the hundreds across the desert, including two *Velociraptor* skeletons, and a dramatic dune-swept canyonland marked by a sandstone column that had to be the red tower of Ulan Tsanchi.

With great eagerness, Currie, accompanied by Tyrrell and Chinese crews, returned in July 1988 to Ulan Tsanchi. Like the Swedes, Soviets, and Chinese before him, he found nothing other than raging sandstorms. But within view, (when the dust settled, twenty-five kilometres to the west), were the cliffs of Bayn Mandahu (Rich Spring). Here was yet another outcrop of the same Djadokhta Formation that had yielded so many specimens at the historic Flaming Cliffs. And this one proved to be the richest yet in the Gobi for dinosaur remains.

As they sifted through the loose sandstone the Dinosaur Project team was rewarded, almost instantly, with spectacular finds. Tyrrell Museum preparator Kevin Aulenback hadn't even started to dig when he found an embryonic skull of a *protoceratops*, a beautiful specimen the size of a twenty-five-cent piece. Zheng Jiajian spotted an even tinier, perfectly preserved skull of a Cretaceous mammal, which was perched on a small rise. Noble was casually scooping away the sandstone, accompanied by

PHOTOGRAPHY: THE EX TERRA FOUNDATION

Kevin Aulenback, a technician with the Tyrrell Museum of Alberta, came upon five different kinds of dinosaur fossil egg-shell, from dinosaur eggs small and large, thick- and thin-shelled, spherical and oblong. This was the greatest assortment ever discovered from a Central Asian site. Here he is extracting the shell of one egg from a dinosaur nest.

some Chinese journalists, when he spotted several dinosaur teeth on the ground. As he dug further he found a tail. More experienced diggers joined in. The tail led to two heads.

"Something very strange was going on," recalls Currie. With a bit more excavation the picture cleared. Here were five baby pinacosaurs, a form of ankylosaur, huddled together as they had died, pinned beneath a collapsing sand dune. Ankylosaurs had previously been known in Asia and North America only as isolated adults. Nothing was known of their social habits, nor of their development. But here, in a group, were the re-

The Canadian-Chinese finds give fresh evidence of a large-scale genetic exchange between the continents. Yet not all the fossil signs point the same way on the dinosaur interchange issue. At the museum in Ulan Bator, Outer Mongolia, there are specimens that might provide more pieces of the dinosaur movement puzzle.

mains of five juveniles the size of small sheep, too young to have developed the bony armour and tail clubs characteristic of their parents.

The mass grave was the most spectacular but far from the only noteworthy discovery at the site. Small mammal skulls, significant in themselves as well as reliable indicators of the age of the deposits, were found by the dozen. Partial remains of tens of other pinacosaurs were found, near to eggs of the same shape as those first found by Andrews. Andrews, without significant evidence, had ascribed them to *Protoceratops* but, says Currie, "We find them in much closer association to pinacosaurs than *Protoceratops*."

Aulenback came upon five different kinds of fossil egg-shell from dinosaur eggs small and large, thick- and thin-shelled, spherical and oblong. This was the greatest assortment of dinosaur eggs ever discovered from a Central Asian site. Invertebrate palaeontologist Paul Johnston revealed huge tunnelling burrows some four metres long. They are the trails left by ancient insects; the largest trails ever found.

From a sedimentological and scenic perspective, Jerzykiewicz pronounced Bayn Mandahu far superior to the Flaming Cliffs. As he is the only scientist to have studied both, he is uniquely qualified to judge. "Bayn Mandahu is a much larger and even more dramatic outcrop than Bayn Dzak. It is the finest example we have of the Djadokhta Formation."

From his studies of both sites, Jerzykiewicz concludes that what is dune now was dune then. These dinosaurs never lived on the shore of ancient waters as previous palaeontological explorers of the Gobi believed. "They thought the calcium carbonate here had to come from lakes. But recent studies in the American Southwest show the same compounds can be formed in aeolian (wind-blown) sediments."

How had the Americans, Swedes, Russians, and Chinese, all having come so close at Ulan Tsanchi, missed Bayn Mandahu, the best of all dinosaur dig sites? Says Currie, "The dune sand may have been too soft for their vehicles to make it." Without thorough ground or aerial surveys, none of them knew what they were missing.

The unprecedentedly productive Chinese-Canadian digs at Bayn Mandahu were cut short by prearranged plans to press on four hundred kilometres to Iren Dabasu, where Dong, Russell, and three of his National Museum of Natural Sciences staffers were to join the crew. The journey along meandering, deeply rutted and unmarked ancient caravan trails took ten days, with stops to toast local officials in devastating all-night feasts of raw mutton fat and potent *mao tai*.

As usual, delays, debates, and diplomatic niceties took up much of the scientists' time. In Xinjiang, Currie and Russell had taken their turns with jackhammers in the quarry with the hearty approval of Dong, who was eager to set an example for the not-always-energetic Chinese workers. The brief presence of Noble's spouse, and the Canadians' preference for scattered siting of their tents did not, however, meet with the Chinese sense of field-camp protocol.

In the border city of Ehrenhot, a few kilometres from the ruins of the telegraph station and the Iren Dabasu site, differing cultural standards surfaced. The ebullient Aulenback was reprimanded for keeping his shirt too far unbuttoned and dancing too close to a Chinese woman at one of the festivities. At the Ehrenhot hotel, Chinese and Canadian workers were instructed to sit at separate tables, thwarting a growing sense of comradeship. As always in China, drivers ruled the daily schedule, balking at leaving for the digs before 8:30 a.m. and insisting on three-hour lunch breaks.

Notwithstanding such byzantine and disruptive dealings, the low mounds of Iren Dabasu, cut by ancient river channels that broke and scattered dinosaur bones, yielded many significant fragments. The Chinese, ever lusting after large museum specimens, plunged into the vast blue-boned hadrosaur beds, chock-a-block with huge bones. Currie looked instead to the less spectacular but often more informative small fossil scatterings. Ironically, these were concentrated in particular abundance by erosion of the bulldozed mounds left by the Sino-Soviet palaeontologists. Currie discovered several isolated teeth of carnivores, which he was able to match to specific theropods.

Among these carnivores were *Velociraptor*, and a tyrannosaurid, *Aublysodon*. The discovery of such small hunters, known to be from the end of the dinosaur era, together with bird-mimic dinosaurs and others previously thought to be far earlier Cretaceous creatures, puts the kibosh on Andrews's and the Soviet dating of the Iren Dabasu material as earlier than the Flaming Cliffs dinosaurs. Instead, the fauna suggests to Currie, and the shape and look of the basin to Jerzykiewicz, that this site belonged to the Nemegt Formation and dates some five to ten million years after the Flaming Cliffs discoveries.

And these finds give fresh evidence of a large-scale genetic exchange between the continents after all. The small theropods found at Iren Dabasu are indeed com-

PHOTOGRAPHY: THE EX TERRA FOUNDATION

One of the most common dinosaurs discovered in Mongolia is a small, horned vegetarian named* Protoceratops. *The animal appeared to be an ancestor of* Triceratops, *one of the ceratopsians (horned dinosaurs) that were abundant in western Canada just before the demise of the dinosaurs approximately 65 million years ago.

mon to North America and Asia. Add to them six distinctive foot-bone fragments found from *Elmosaurus rarus* which, as the name implies, is so rare that Currie's Iren Dabasu haul equals the previous known worldwide take. Half of those were from Mongolia, half from Alberta, adding strength to Currie's theory that "all the small theropods are basically the same in late Cretaceous North America and Asia."

Further substantiating this belief are the still unpublished Albertan finds that Currie saw more than a decade ago. Those fossil discoveries reveal that at least two of the three kinds of pachycephalosaurs that Kielan-Jaworowska found in Mongolia and thought unique to Asia are found in North America as well.

Yet not all the fossil signs point the same way on the dinosaur interchange issue. Currie also found considerable remains from *Alectrosaurus*, including, on his last scheduled morning at the site, what he thought to be the first furcula (collarbone) of the species ever found. *Alectrosaurus* is a peculiarly Mongolian dinosaur. Why didn't it make it to North America? And still no evidence was found of a single ceratopsian in Asia.

Moreover, *Elmosaurus*, the ornithomimids, and the hadrosaurs found at Iren Dabasu resemble more conservative earlier species, retaining more primitive features, alongside more derived late Cretaceous species like *Aublysodon*. Why are the holdovers living on in the Nemegt? In North America, Horner and others found that more conservative species persisted on uplands, alongside a shifting inland sea. Currie speculates, "Perhaps we have a similar environment here, closer to that in North America if not the same, a dry area near the coast."

Iren Dabasu is nowhere near the ocean now. Currie was, however, within sight of Mongolia, where there is a host of other excavated specimens, studied and unexamined, that might provide more pieces of the Asian-American dinosaur movement puzzle. But the expedition was moving south in China to Alashan and Ordov, and fifty million years back in time. Dale Russell found a strange armoured dinosaur and a small theropod.

I reaped the fruits of *glasnost* and weeks of bureaucratic wrangling when I was finally allowed to cross into Mongolia. At the museum in Ulan Bator, palaeontologist Artangel Perle welcomed me and the prospect of a visit from Currie. I told him of Currie's fresh discovery of the first known *Alectrosaurus* furcula. "Very nice," he replied graciously, "of course, we have one of those."

I flew on to the Mongolian Gobi and hired a driver to take me to the Flaming Cliffs. There before me was the vast basin that in the words of Andrews is "studded with giant buttes like prehistoric castles." At my feet were two white rounds of bone, unmistakable bits of dinosaur vertebrae. There are still dinosaurs to find and their mysteries to solve in the Gobi.

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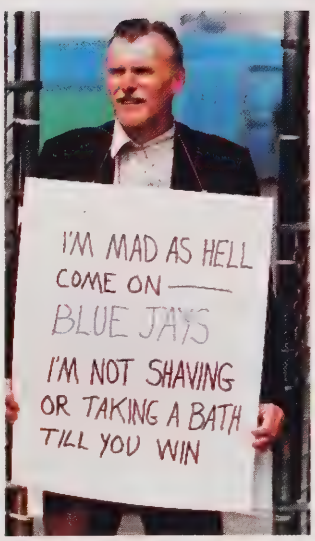
The exhibition Let's Play Ball, *organized by the Royal Ontario Museum, will be on display from 1 March until 4 September 1989.*
The Royal Ontario Museum gratefully acknowledges the generous support of Labatt's and the Toronto Blue Jays, which has made this exhibition possible.

Winning And Losing: Its All In The Game

Can we will a favourite team out of a slump?

Stephen Jay Gould

The laws of probability rule much of our universe. Perhaps the greatest impediment to public understanding of science lies with our inability or disinclination to live with lady luck and to view patterns as uncaused and undirected in any meaningful sense. One of our largest subcultures, from the moguls of Las Vegas to the three-card monte players on the streets of New York, makes its copious profit because enough foolish people so deeply believe that they can beat the odds with a system or a prayer.



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The subject of streaks and slumps in sports provides my favourite illustration of this gap between conviction and actuality. Everyone knows that long sequences of victories or defeats are influenced and extended by the general mood of joy or despondency that regulates group psychology. Everyone also knows that the best individual players can work themselves into grooves, and go on a tear of success far beyond the predictions of their usual play—the phenomenon called "hot hands" by basketball fans.

Yet extensive studies have shown over and over again that no such phenomenon exists—though nothing from science or statistics will ever convince sports enthusiasts that their most cherished subject of conversation is entirely chimerical. Runs of baskets do not exceed, in length or frequency of occurrence, the expectations of random

Stephen Jay Gould, a professor at Harvard University, is a regular essayist for Natural History *magazine, published by the American Museum of Natural History, New York, and a frequent contributor to other magazines. His fascination with natural history and evolution is almost matched by his love of baseball.*

Slumps are usually blamed on everything from bad vibes to bad playing conditions. Few people ever consider an obvious cause—simple bad luck.

models based on the average shooting percentage of individual players. (Great players have longer runs only because their average percentage is higher, not because they can draw special strength from the heart of their courage or valour.)

Every streak and slump in baseball has been subjected to this analysis, and nothing in the entire history of the sport has happened either more often or for a longer run than random models predict. Nothing, that is, except for the event that most baseball aficionados rate as the greatest achievement in the sport's history—Joe DiMaggio's 56-game hitting streak in 1941. In this case, the intuition of fans is correct, for DiMaggio's streak is also baseball's only successful assault upon Lady Luck. (See my analysis of DiMaggio's streak in the *New York Review of Books*, 19 August 1988.)

I was prompted to rethink the problem of streaks and slumps following two recent events experienced by baseball's ornithologists—the spectacular collapse of the Toronto Blue Jays at the end of the 1987 season (sorry folks, but I was rooting for you), and the much worse plight of the Baltimore Orioles at the very beginning of the 1988 season.

The Orioles initiated their season with the longest losing streak in the history of baseball openings—21 straight defeats. All commentary, endless and merciless as usual, focused on the causes and reasons. Suggestions ran the gamut from bad vibes to bad playing conditions, and even to a vengeful god of racism, out to punish Frank Robinson, baseball's only black manager. No one even mentioned the obvious alternative—simple bad luck. The birds almost won several of those games.

How unlikely are 21 straight losses right at the beginning of a season? That all depends upon how bad a team you are. If you usually play .500 ball, winning and losing about the same number of times, then the problem reduces to coin-flipping—specifically, in this case, the probability of flipping 21 tails in a row: 0.5^{21} or about 1 in 2 million.

But we cannot work the calculation this

Winning streaks, like slumps, are not subject to a special "causality of circumstance" that can dramatically change a team's performance.

way. Baseball teams are not coins; some are better than others. (Remember that the random models do not deny real differences among teams and individual players. The models only assert that streaks and slumps can be explained as random sequences of runs based on probabilities established by the ordinary play of a team or individual. There is no special "causality of circumstance" that raises the probability of success during a streak.)

Since long losing sequences tend to strike the worst teams, we might base our calculation on the average record of baseball's worst teams since the beginning of major league play in 1876. I therefore calculated the average winning percentage for all last-place teams in major league history, and got .331 (the Orioles, as I write this piece in early August, stand a bit lower at .317). This means that the characteristic losing probability for a last-place team is 1.000 minus .331, or .669. If the random models hold, and slumps only record bad luck, then the chance of losing 21 straight for worst teams is $.669^{21}$. (The probability of losing doesn't rise because you're in a slump, just as the chance of tails remains 0.5, even if you have flipped 20 tails in a row just before.) Now $.669^{21}$ is .000216, or 1 in 4630. In other words, once in 4630 sequences, we would expect a last-place team to lose 21 games in a row.

But 4630 sounds like a large number of sequences, and major league baseball has been played only for a little more than a century—so maybe the random models don't work, and the Orioles were the victims of some special losing virus. But think about it again. Considering all American and National league seasons, from 1876 through 1987, 237 last-place teams have had a chance to start a season with 21 losses.

Therefore the birds' 21-game slump occurred after 237 tries, or about 5 per cent of the 4630 sequences that would lead us to expect a 21-game slump. A bit early you say? Perhaps. But you surely can't argue that Baltimore's was something wildly improbable, or especially surprising.

Baltimore's distress was a truly massive

How unusual was the Boston Red Sox's twelve-game winning streak last summer? According to calculations the only surprising aspect of the streak is that it didn't happen sooner.

slump—far, far worse than the usual sequences that journalists and sportscasters discuss for hours in unquestioned causal terms. For example, as I write this article, my local Boston Red Sox have just completed a 12-game winning streak, their longest since 1948. This streak coincided with the hiring of a new manager, Joe Morgan. You can imagine the attempts at causal explanation. But how unusual is a 12-game streak? Since 1948 the Sox have had their ups and downs, but they have hovered around .500 overall—so let's use the easiest coin-flipping model. Twelve straight is 0.5^{12}, or 1 in 4098. Since the start of the 1949 season the Sox have played about 5800 sequences of 12 games. Thus, the only surprising aspect of the recent streak lies in delay. It could easily have happened years ago. Wade Boggs, the Sox's frank third baseman, and the best hitter in baseball by far, correctly attributed the streak to "coincidence."

If the analysis of streaks and slumps dispels one myth about heroism and causality in baseball, the data that I accumulated to exonerate the Orioles also provided more evidence to dispel baseball's second myth—the legend of past greatness. (Since legends about streaks of success and past golden ages are central ingredients in mythology of all genres, musings about baseball do suggest that the old cliché about sport imitating and informing life may have some validity after all.)

In calculating the average winning percentage for last-place teams, I proceeded in chronological order from 1876 to the present. As I went along, I noticed a strong pattern. Last-place teams have never been very good, of course, but they have consistently improved their winning percentages through time—from an average of .233 in baseball's first decade to .394 in the 1970s.

This rise for losers implies that the winning percentages of league-leading teams must have declined. So I returned to my *Baseball Encyclopedia* and spent a few more happy hours calculating at the other and more pleasant end of the spec-

Probability and baseball

TO BETTER UNDERSTAND THE PHENOMENON of unusually good (or bad) *luck* in baseball, it's necessary to understand a little about the *odds*. The best place to start is with a far less complex situation than a baseball game.

Consider the outcome of a simple action like flipping a coin. Only two outcomes are likely: either the coin comes down heads or it comes down tails. And because it is symmetrically balanced when it flips through the air, it is just as likely to come down heads as tails. (The likelihood that the coin will land and balance on its edge is so slight that it's not worth considering.)

In order to define the concept of chance, or the *odds* of a particular event's happening, a mathematical calculation of probability was developed. Returning to the example of the coin, it is a fact that if the same coin is flipped one thousand times, on average it will come down heads about 50 per cent of the time, tails about 50 per cent of the time, and either heads or tails 100 per cent of the time. Stated in the formal language of probability theory, a probability of 0.5 is assigned to a flipped coin's landing heads and a probability of 0.5 is assigned to the same coin's landing tails. Therefore the probability of the coin's landing either heads or tails is 0.5 + 0.5 = 1, which means that it is 100 per cent certain that it will be one or the other.

Rolling a die is a more complex event because there are six possible outcomes. If the die is fair, that is, evenly balanced, and is rolled a great number of times, then each of the numbers from 1 to 6 will come up about one sixth of the times (16.67 per cent or a probability of 0.1667).

You can apply this kind of thinking to any event in the real world—like the outcome of a baseball game—even though you don't know beforehand what the chances are that a team will win a game. Unlike the outcome of flipping a coin, winning a baseball game is a complex event that will depend on the strength of all the players on both teams plus quite a few other things. But you can go back over the records of each team to find out what percentage of its past games each team has won. That will give you the probability of each team's winning any particular game (for example, 287

When the formidable Cleveland Indians lost the World Series in four straight games to the New York Giants in 1954, one deliriously happy fourteen-year-old won about fifteen bucks.

trum. The average winning percentage of league-leading teams, averaged by decade since the beginning of major league baseball, is down, down, down—and remarkably uniform, with only one unexplained exception for the 1920s.

The year-by-year details are fascinating and affirm the power of the pattern; these averages are not hiding great fluctuations for individual years amidst a weak overall tendency. In the first decade of the 1870s only one winning team dipped below .700 (Boston at .683 in 1878). The first value below .600 was set by the Detroit Tigers, who finished at .588 in 1908. On the other hand, in the 1970s half the winners (10 of 20) have finished below .600, with the 1973 New York Mets at an astonishing .509 for the lowest value ever. (The amazin' Mets almost won the World Series after their dubious season, but lost to Oakland in the 7th game on a home run by Mr. October himself, Reggie Jackson.) The last team to exceed .700 was the greatest club that I have ever seen—the 1954 Cleveland Indians, with a formidable pitching staff of Bob Lemon, Early Wynn, Mike Garcia, an aging but still able Bob Feller, and a .721 winning percentage. General averages do not regulate short sequences (thank goodness). The Indians then lost the World Series in four straight to the New York Giants, and one deliriously happy fourteen-year-old kid—me—bet all his money at very favourable odds on the home team, won about 15 bucks, and felt like the richest kid in New York.

The regularity of this downward trend through more than a century disproves the usual explanations offered for low recent winning percentages—greater equalization of wealth among teams, divisional play, free agency and greater mobility of players, collapse of the minor leagues with talent sold to highest bidders, and expansion drafts. All these phenomena belong only to the past 20 years; the trend is a feature of baseball's entire history. The decline has not even accelerated since the equalizations wrought by free agency.

The usual explanation for this and other similar patterns evokes the myth of

wins in the last 575 games is 49.9 per cent of games won, which means a probability of winning of 0.499). This is a little like rolling a die 1000 times and counting the number of times that one specific number comes up.

Back to coins. What are the chances that a flipped coin will come up heads twice in a row? The probability of a head on the first throw is 0.5, and the probability of a head on the second throw is still 0.5. However, by looking at all the possibilities, 2 flips of the coin could result in a head followed by a tail, a head followed by a head, a tail followed by a tail, or a tail followed by a head (see table).

From this simple listing, it's easy to see that only 1 of the 4 possible outcomes gives rise to 2 heads in a row. Thus 2 heads in a row will happen about 25 per cent of the time in a sequence of two flips; therefore the probability is 0.25. The same result could have been calculated by multiplying the probability of a head on the first flip with that on the second flip:

$$0.5 \times 0.5 = 0.25$$

The four possible outcomes of flipping a coin twice

First flip \ Second flip	H	T
H	**HH**	**HT**
T	**TH**	**TT**

Similarly the probability of rolling a die 5 times and turning up the same number each time is

$$0.1667 \times 0.1667 \times 0.1667 \times 0.1667 \times 0.1667 = 0.0001286$$

or more simply stated:

$$(0.1667)^5 = 0.0001286$$

So if a baseball team wins 45 per cent of its games, then the probability of its winning any particular game is 0.45, and the probability of its winning 2 games in a row is

$$(0.45)^2 = 0.2025$$

Furthermore, the probability of this team's winning 10 games in a row is

$$(0.45)^{10} = 0.00034$$

This means that in any sequence of ten games played by the team, there is only about three one-hundredths of one per cent probability that the team will win all 10 games —not very good odds. But if 10 games were to be played by a more successful team, say one that wins 85 per cent of its games, the odds improve to 19.68 per cent or about 1 in 5—not bad odds at all.

DAVID BARR

It is a myth that great teams of the past reached consistently higher winning percentages because they cared more, tried harder, and played better.

a past golden age, when men were men, spit tobacco, played even when hurt, and sometimes hit .400. Great teams of the past reached consistently higher winning percentages because they cared more, tried harder, and played better.

The trends are real and general. They apply to the batting averages and earned-run averages of league leaders, as well as to entire teams. The early days of baseball witnessed higher values for excellence. Ironically, however, the proper interpretation of such decrease through time is exactly opposite to the knee-jerk, first impression that these trends must be measuring a decline in the quality of play. These trends, in fact, can only be recording the average *improvement* of major league baseball through time.

Several years ago, I studied patterns in batting averages while trying to solve the problem of why no one hits .400 any more (see my book, *The Flamingo's Smile*). Such high averages were common during the early days of baseball through the 1920s, but the last .400 hitter was Ted Williams in 1941, the year of my birth. I discovered that the disappearance of .400 hitting does not mark the destruction of excellence, but emerges as a consequence of general improvement through time. The mean batting average has stood at about .260 throughout the history of baseball (because hitting and pitching remain in balance as both improve). But extremes at both ends—the highest and the lowest individual averages—have consistently moved towards the mean. No one hits .400 any more because the difference between average and best has declined so drastically through time.

This constant decline in the difference between average and best can only record the general improvement of play. Any age contains a few stars born with the gifts, and obsessive enough to undergo the training, that bring a man to the peak of human possibilities. In the past, these rare individuals often exceeded .400 because average quality of play was so poor relative to modern standards. Today, the difference between ordinary and best has de-

What's happened to baseball?

A century of decline in average winning percentages of league-leading games, calculated by decade

The improvement in play over the decades has shaved the average differences between teams. This does not mean that the game has become a machine of proper execution.

creased substantially as the great improvement of average play brings the mean closer and closer to this unsurpassable limit of excellence. Wade Boggs would have hit in the .420s early in our century; today he leads the majors at .360.

This general improvement in play also shaves the average differences between teams. There are now enough good players to go around. Baseball contains no patsies. All teams are good, and the best cannot rise to previous heights of winning percentage on the backs of true mediocrity. General improvement must entail a reduction in percentage differences.

But, as a final word of good cheer, such improvement does not mean that heroes are gone, and that baseball has become a machine of proper execution. Better average play is a blessing to all fans. Would you rather see Ty Cobb lording it over ineptitude, or a series of well-played games with tense and uncertain outcome. Individual differences will always remain. In a way, the importance of excellence only increases when it must rise above such a high standard. Besides, general trends, however inexorable they may be, tell us nothing about the outcome of individual events. And sport, thank goodness, is a panoply of unpredictable particulars. No general statistics could ever have specified that Don Larson would pitch a perfect game in the World Series of 1956, or that Harvey Haddix could pitch 12 perfect innings and then lose the game.

Baseball, played under constant rules for a century, and blessed with a complete dossier of record, provides an unparalleled source of data for the general study of trends in systems operating under stable conditions through time. Nature often works in a similar way, but almost never provides data of such richness. With proper care, and attention to differences, we can learn a great deal about the general behaviour of systems by studying the history of baseball. There is more potential contact between baseball and natural history than Dave Winfield striking a seagull in Exhibition Stadium.

Let's Play Ball

An exhibition in Nine Innings at the ROM, 1 March to 4 September

PHOTOGRAPHY, RICHARD SWIECKI

Let's Play Ball is an exhibition that explores the history, traditions, and rituals of baseball, and contains the largest single loan of historically significant artifacts and priceless memorabilia to ever leave the National Baseball Hall of Fame and Museum in Cooperstown, New York. More than 350 important baseball objects also have been collected for the show from other institutions across North America.

The exhibition will transport visitors inside the world of baseball where they can take a closer look at how baseball equipment is manufactured and participate in the game through a variety of interactive, hands-on displays. The scientific aspect of baseball will be explored when visitors step into the batter's box and experience the sensation of a 144-kilometre-per-hour fastball sizzling towards home plate. The ways in which baseball has mirrored social trends and responded to social change, from the Negro leagues to the professional female players, will also be examined.

The Royal Ontario Museum gratefully acknowledges the generous support of Labatt's and the Toronto Blue Jays, which has made this exhibition possible.

The technolog

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`Ain Ghazal: A Neolithic Village In Jordan

Ignored by biblical archaeologists for years, the site of 'Ain Ghazal is proving to be a treasure trove of information about the New Stone Age

Dan Rahimi

Above: The Venus of 'Ain Ghazal is one of the exquisite mysteries of this Neolithic site. Like many other figurines found in the region, she is headless. Her full form suggests pregnancy, and the decoration on her body may represent scarification.

Facing page: A tent provided protection for statues that just had been recovered at the 'Ain Ghazal site, located along the roadcut of a super highway. There is a jarring contrast between the modern world and the remains at the site, which date from the very dawn of civilization.

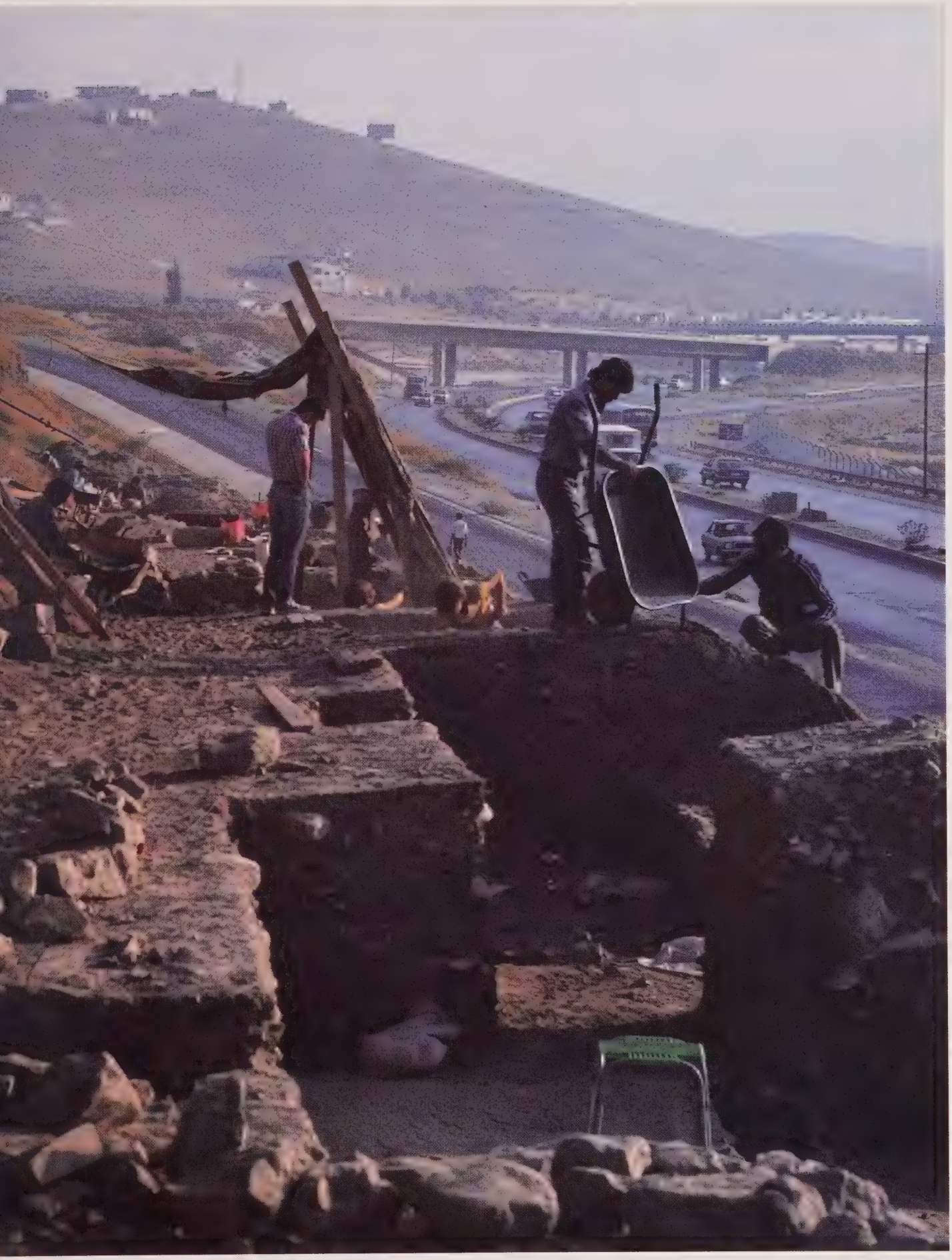
Amman, the capital of Jordan, illustrates the often turbulent history of the Middle East in a fashion that only the ancient centres of Damascus and Jerusalem can equal. Although once again a thriving centre, at the turn of this century Amman was little more than an Ottoman village, a far cry from its status some 2000 years ago as the famed Roman city of Philadelphia, with an acropolis crowned by the Temple of Hercules. In an earlier era, it was called Rabbath-Ammon, the capital of the biblical Ammonites. From a still earlier time, the Middle Bronze Age (around 1600 B.C.), there are only the remains of tombs and temples from a city whose name has been lost to the ages. And so it is only fitting that recent excavations have shown this perennial—albeit sporadic—capital to have had a still more ancient incarnation. During the Neolithic Period, some 9000 years ago, it was a leading centre in the development of village life and agricultural subsistence. Today the site is called 'Ain Ghazal.

During the dramatic expansion of Amman in the second half of the present century, hundreds of archaeological sites were exposed. Luckily a number of highly skilled Jordanian archaeologists, some trained locally and others educated in Europe and North America, as well as archaeologists and biblical scholars from all over the world were available to protect and excavate the sites. As the first spades began turning the earth, the soil of Jordan proved to be a treasure trove for biblical and classical archaeology. But the story of the discovery of pre-biblical 'Ain Ghazal shows how a predominantly biblical orientation to the study of Jordan's ancient past skewed the archaeological picture for quite some time.

In the 1970s, a major highway was constructed running north from Amman. It followed the Wadi Zarqa, the river course that originates in the city and soon empties into the Jordan River. In widening the existing roadway to a four-lane super-highway, the bulldozers cut into the hillside of the ancient riverbank. The vertical section that was exposed revealed horizontal bands of white plaster, indicating the floors of ancient houses similar to those being uncovered so frequently at other Jordanian sites. But the

Dan Rahimi is project coordinator for the Royal Ontario Museum's new European and Egyptian galleries.

PHOTOGRAPHY, DAN RAHIMI



first archaeologists to visit this site were disappointed by the absence of the potsherds that were so typical of the sites of biblical Jordan. As a result the find was dismissed as an oddity, perhaps a natural phenomenon, that held no promise for excavation.

It was not until 1976 that a curious archaeology student, who passed the site daily on his way to the University of Jordan, mentioned it to his professor, Dr. Khair Yassine. Yassine, an archaeologist of the biblical period, was engaged at that time in excavating an Iron Age site in the Jordan Valley, but he knew of the cultures belonging to what scholars called the Pre-pottery Neolithic. An impromptu field trip to the site confirmed his suspicions. There, scattered in thousands over the low hillside, were the stone tools of the prehistoric inhabitants who had mastered the art of creating plaster for their houses, but who knew nothing of pottery or ceramic techniques. This discovery, though undoubtedly satisfying to Yassine, caused little stir in the greater archaeological community. Stone-age sites were neither rare nor of interest to biblical scholars in Jordan.

PHOTOGRAPHY, B. BYRD

The statues are among the most ancient human sculptures known. Nearly 9000 years ago they were carefully laid in a circular pit dug through the superimposed floors of abandonned houses. They are so fragile that they had to be carefully removed in a block of earth, measuring one cubic metre, that was fit into a specially constructed crate.

Enter Dr. Gary Rollefson, a prehistorian trained at the University of Arizona, who had been engaged as a teacher by Yarmouk University, the new university in northern Jordan. He was interested in the very earliest human occupation of the Middle East, the Palaeolithic or Old Stone Age. For him, accustomed as he was to finds dating back at least 80,000 or more years, the Neolithic of 7000 B.C. was almost modern.

Yet he knew of the potential importance of a Pre-pottery Neolithic site in Amman. The discoveries in the very earliest levels of Jericho, the greatest site of this period, together with those of Beidha (in the south of Jordan) had revealed new information about the development of civilization and thereby had brought a new perspective to studies of the Neolithic. This new site might possibly provide a bridge across a geographical and a cultural gap: located between the two best-known Pre-pottery Neolithic sites in Jordan, it might yield evidence connecting Jericho and other sites west of the Jordan River with those in the east.

Jordan possesses a wide variety of geographical conditions, but human beings have been able to adapt themselves and to occupy the region for well over 100,000 years. In the Jordan Valley, the lowest point on Earth, the summer climate is oppressive. Temperatures commonly rise above 40°C, and humidity can be extreme. The floodplain of the river is narrow, and rises quickly to form the mountains of the West Bank on one side, and the plateau of Jordan on the other.

The city of Amman is situated about nine hundred metres

The material finds at 'Ain Ghazal have been nothing short of spectacular, and the contribution to our understanding of the changes in human society at the time of the first farming villages has been profound. From the earliest Pre-pottery levels have come the most ancient human sculptures known.

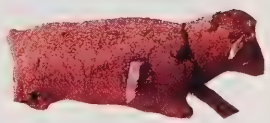
above sea level, and while summer temperatures easily reach the high 30s, the dry air quickly loses its heat when the sun sets, and evenings are cool and pleasant. In winter, one may descend from the snowy region of Irbid, home of Yarmouk University, to the springlike warmth of the valley in the space of forty-five minutes. In this descent there is a wide change in both vegetable and animal life; as a consequence, a nomad population can find sufficent food all year round.

Modern 'Ain Ghazal, "spring of the gazelle," does indeed have a spring. Much of its land is given over to olive and apricot trees; bees are kept to pollinate the blossoms, and a garden of eggplant and squash leads up to the single house on the site. The house is made of cinder block, with a patched roof of corrugated iron, and the surrounding domestic refuse—rusty oil drums, discarded water boilers, broken floor tiles, and tins of cooking oil—continues a tradition of unintentional site building that is millennia old. The house is perched atop ancient 'Ain Ghazal, its foundations set in houses dating to 7000 B.C. It is not the only reminder of modern times. The old men who pass by the site with their donkeys every day have to walk along the shoulder of a loud and dirty highway. Overloaded diesel trucks roar by, and the fumes and the noise deny the site the dignity that its antiquity would have conferred. In my first year of digging by the road-cut, a scant four metres from the traffic lane, I had to shout to be heard by my colleague, even as we examined an object as delicate as the *Venus* of 'Ain Ghazal.

The site of 'Ain Ghazal occupies about one kilometre of land along the Amman-Zarqa highway. Its width is difficult to determine, for part of it was lost to the highway and there are no surface architectural traces of the remainder. The only way to establish the extent of the site is to dig test trenches progressively up the slope. Although this testing is not complete, it may eventually reveal that the site stretches as far as the bedrock limestone outcrop at the hillside's upper reaches. If the site were to extend that far it would have an area of about ten hectares, making it the largest Neolithic village in Jordan.

But perhaps more impressive than its breadth is the depth of the deposits of human occupation. In a deep sounding conducted over four seasons of work, we have found superimposed building layers descending as much as six metres. These consist of the remains of houses built of sun-dried mud, stone, and plaster that have collapsed or have been destroyed, then levelled and built upon time and again.

Rollefson began excavations at the site in 1982, and nearly every summer since then some fieldwork has been done. The involvement of Yarmouk University has grown. Although Rollefson has now taken a teaching post at San Diego State University, Dr. Zeidan Kafafi, the Neolithic specialist at the Institute of Archaeology and Anthropology of Yarmouk University, has become co-director of the site. Trained at the University of Jordan and in Berlin, Dr. Kafafi has brought to the project more than just his academic expertise. He could humour the diggers, as we worked together in the unrelenting sunshine of July, and he could kindly and paternally guide his young students in their first experiences with a trowel. His enthusiasm matched that of Rollefson, and together they are conducting the most prominent project in Jordan, staffed equally by Jordanians and North Americans.



PHOTOGRAPHY: C. BLAIR

PHOTOGRAPHY: G. ROLLEFSON

The clay figures, which were pierced with flint points, probably represent wild cattle. Miniature figures of people were also found at the site.

The rewards of the 'Ain Ghazal excavations are great. The material finds have been nothing short of spectacular, and the contributions to our understanding of the changes in human society at the time of the first farming villages have been profound. From the earliest Pre-pottery levels have come the most ancient human sculptures known: two caches of plaster statues, about ninety centimetres high, that were ceremonially buried among numerous smaller busts with finely moulded heads. Great attention was paid by the sculptors to the facial details. The eyes, made of bright white chalk or plaster, are finely outlined, and the pupils are marked with bitumen, a tar inlay. Red paint was used to tint the cheeks, and stripes were painted on some foreheads. By contrast the bodies show fewer features, though the curves of legs and hips were such that our crew agreed that most were female.

The statues and the plaster skulls reflect a religious practice of profound importance. Whether they are symbols of ancestor worship or elements of an arcane ritual is not clear. However, the prominence given to these objects during the Neolithic must place them at the centre of religious life.

PHOTOGRAPHY, DAN RAHIMI

Thirty-two human burials were found at the site. A number situated under the floors of houses were intact from the neck down, but the heads had been neatly severed at the first vertebra and removed. The lower jaws were left with the skeletal torsos. Finding the decapitated skeletons sent the expectations of the archaeologists soaring, for they were fairly certain of the dramatic discoveries to follow.

Nearly 9000 years ago the statues were carefully laid in a circular pit dug through the superimposed floors of abandoned houses. They were arranged side by side and in layers, with at least one layer at right angles to the rest. The smaller busts encircled the whole group. We discovered that the plaster bodies had been moulded around a core of reeds wrapped in twine. In the course of time the reeds had disintegrated leaving only their impressions in the plaster, and the statues had collapsed. Any attempt to remove individual figures would have proved disastrous. The director of the Department of Antiquities came to the rescue. Dr. Hadidi phoned the Institute of Archaeology in London and requested the assistance of their plaster conservator, Kathy Tubb. Ms Tubb was flown to Jordan the next day, and there, six months pregnant and forced to work lying on her side, she began the laborious task of consolidating the pieces.

It was clear, however, that even with consolidation the pieces could not be removed safely in the field. With the help of the archaeologists, Tubb devised a risky scheme for removing the statues as a single unit. A huge block of earth was cut on four sides, and then carefully undermined. Next, the bottom of a specially constructed crate was positioned under the block and the sides of the crate were fitted. With the figures immobilized in polyurethane foam, the lid was sealed. In this way, nearly one cubic metre of earth was enclosed, to be hoisted by block and tackle and flown to London, all without the slightest mishap.

In the same summer that the statues were unearthed, thirty-two human burials were recovered. The discovery of a number of headless burials sent expectations soaring. These skeletons were

intact from the neck down, but some time after burial and decomposition the graves had been disturbed and the heads had been neatly severed at the first vertebra and removed. The jaws were left behind with the other bones.

The cause of the excitement was not this bizarre burial practice in itself, but the anticipation of what we knew was to follow. In the excavation of Jericho in the 1950s, a similar pattern had been revealed from the Pre-pottery Neolithic. There, for the first time, skulls were found buried under the floors of houses. Amazingly, faces had been shaped on the skulls with moulded plaster. Sometimes shells served for eyes, and there were traces of paint. Each face was different, each head unique. (The Royal Ontario Museum was one of the sponsors of the Jericho excavations, and Dr. A. D. Tushingham participated as a field supervisor under the direction of Kathleen Kenyon. Dr. Tushingham brought back to Toronto one of the plaster skulls from Jericho, and it may be seen in the Mankind Discovering Gallery at the Museum.)

At 'Ain Ghazal skulls were found singly, in pairs, and in a group of four, all buried under the floors of houses as they had been at Jericho. The houses themselves are simple rectangles, averaging about four by five metres in area, with walls made of stone often preserved to more than a metre in height. The houses' most impressive features are their floors. Made of highly refined lime plaster, the floors were laid, burnished to a high polish, and sometimes painted. Red seems to have been the favourite colour, followed by orange/yellow. Built into the floors of many of the rooms were hearths—basinlike depressions filled with the ash of ancient fires. The floors were hard, and even without cracks, as shiny as if they had been freshly varnished, but with one glaring defect: in a number of houses the floor had a patched circle about thirty centimetres in diameter, and many had larger repairs up to a metre in size. Almost predictably, the smaller holes contained skulls and the larger ones decapitated skeletons.

The statues and the plaster skulls reflect a religious practice of profound importance. Whether they are symbols of ancestor worship (were the plaster faces modelled after the living?) or elements of an arcane ritual is not clear. However, the prominence given to these objects during the Neolithic must place them at the centre of religious life.

PHOTOGRAPHY, DAN RAHIMI

Three skulls were found under the floor of a house. They had facial features shaped on them in moulded plaster. Almost predictably, small holes found under the floors of the houses of 'Ain Ghazal contained skulls, and large holes contained decapitated skeletons. Such burials were first discovered in Jericho.

Less dramatic perhaps but also part of the repertoire of religious objects is a series of animal and human figures, mostly of clay. The human figures are few in number and highly stylized, whereas the animals are numerous and more natural in their forms. There are many representations of wild game, some ritually killed with flint points. These probably depict wild cattle; the bones of the real animals have been found in the domestic refuse of the houses. Were these figures charms for the hunters or were they no more than children's toys with the flint points representing the hunters' spears?

Archaeologists must question the function of the figures in the context of the evolution of farming villages in the Neolithic. The statues, skulls, and figurines of 'Ain Ghazal are part of this change, the products of new technologies and a new social order.

PHOTOGRAPHY, A.D. TUSHINGHAM

Plaster skulls were first discovered at Jericho. These are two skulls from Jericho, excavated by Kathleen Kenyon in the 1950s.

Adaptations To Life In A Bornean Forest

Although they teem with life, the world's equatorial rainforests represent an extremely fragile balance of nature

Stephen V. Nash and Anne D. Nash

Equatorial Rainforests are among the most intriguing yet least understood places on Earth. They support a dazzling variety of plants and animals, but little research has been conducted to discover how so much diversity of life can survive in a single area.

PHOTOGRAPHY, STEPHEN NASH

These yellow-bellied prinias may not have survived to adulthood in the deceptively harsh rainforest environment.

Indonesia, through its Directorate General of Forest Protection and Nature Conservation, is one of several countries that recognizes the importance of preserving these marvellously complex environments, which are being threatened by human resettlement programs and exploitation of their natural resources. In 1986, we were invited by the World Wide Fund for Nature and the Indonesian government to participate in their Protected Areas of Kalimantan Project by helping to improve the management plan for Tanjung Puting National Park, a rainforest preserve located in Central Kalimantan province on the island of Borneo.

A thorough understanding of the ecology of the region was needed before anyone could compose a management plan to preserve it. This required a detailed study of the diverse life and natural history of the 300,000-hectare park, something that had never been produced in spite of the park's designation as a UNESCO Man and the Biosphere Reserve and as an area of "world heritage quality" by the International Union of Nature and Natural Resources.

We decided to concentrate our research on the park's bird life to get an idea of how the birds interact among themselves and with their habitats. Four

Stephen Nash, formerly a technician at the Royal Ontario Museum, is coordinator of the Irian Jaya Project, WWF, Indonesia. His wife Anne is a graduate student affliated with the Faculty of Environmental Studies, York University.

months later, after having netted and spent thousands of hours making observations about 1300 birds, we were surprised to find that the one factor that affected almost every aspect of all the birds' lives—from their feeding, nesting, and courtship habits to their territoriality and song, and from their moult, sex, age, and body measurements to their breeding condition—was food. It was from studying the relationship of different species of birds to their food sources that we obtained an interesting insight into life in the rainforest. In spite of the lush environment, life in Tanjung Puting is harsh and intensely competitive.

The common image of a tropical rainforest is a place overflowing with food for its wildlife. It's true that the constant temperatures and abundant rainfall promote a profusion of plants, which form the base of the food pyramid. Yet we observed that different groups of birds eat only certain foods and often only at very precise times. We examined the eating habits of individual species and groups of species that not only eat the same food but seek, find, and eat it in similar ways. These birds had defined patterns of activity that could be plotted on a graph.

The activity periods are usually affected by temperature. Birds living in the upper forest canopy or open areas are inactive at midday when the temperature is highest; conversely deep-forest-living species are active throughout the day because they are unaffected by the intense midday heat. Yet throughout the hours of the day that are suitable for feeding, the different species competing for food in the same space feed at different times. Such limited diets, and the shared feeding times, clearly suggest that food is scarce.

Even the incredible specialization and diversity found in the forest's animal and plant life is sometimes linked by food. There are species of trees that, in order to ensure rapid and widespread distribution of their seeds, have evolved fruits that are particularly attractive to birds. Other species of trees produce fruit at intervals of more than one year, thereby holding down the populations of seed predators.

In Tanjung Puting the supply of edible insects fluctuates in direct relationship to the plant growth, which in turn is affected directly by the seasonal rainfall, which peaks twice, in April/May and in Decem-

The forest kingfisher feeds only on insects.

This female green broadbill belongs to one of the few species of birds in the rainforest that feeds only on fruit.

The Malaysian blue flycatcher is usually found near water, and feeds on flying insects.

The fluffy-backed tit-babbler lives near the forest edge.

ber, dwindling to a low point in September. A flush of new leaf growth takes place in April, which in turn promotes an increase in leaf-eating insects. As the dry season starts in July, there is an increase of sunlight, which promotes flowering, and this leads to an increase in the insects that aid pollination. At the end of the dry season all insects are at their lowest numbers. This means that the annual supply of insects for food is very predictable and so bird life has adjusted accordingly.

During a bird's life, breeding and moulting are the two most engery-demanding activities. Birds of Tanjung Puting carry out both these activities during the periods of surplus food. The peak of the breeding season takes place during the first increase in insect food, not only for insectivorous birds, but also for fruit-eaters, since these often feed insects to their nestlings.

However, the numbers of nestlings that survive to become adults is very low—in the order of 10 to 20 per cent—because nestlings are popular food for snakes, lizards, mammals, and other birds. That the forest bird population remains stable means that those birds that do survive live long lives, and so few new birds are needed to keep up their number.

Rainforest birds have, as a rule, small clutches; there are rarely more than two eggs. This is not a reflection of the number of young that can be fed at one time but rather of the number that can be effectively protected and taught to survive. Parents must care for their young for periods lasting as long as six or seven months. Consequently, not only do the rainforest birds have smaller clutches but also fewer clutches than birds living in very favourable environments.

Once an attempt at breeding is made, the rainforest birds use the last part of the surplus-food period to moult. Wear and tear on feathers is inevitable, and so plumage must be replaced at least once a year; otherwise the birds are seriously handicapped. Tanjung Puting birds must complete their moults before the lean period for food because during this time there is only enough food to supply the birds' minimum energy requirements. In fact we learned that the quantity of food available during the period of plenty has no bearing on the birds' ability to survive the lean period.

Adult birds generally start their moult as soon as their young are fledged; however, when females have the larger share of incubation duties, the males start to moult well before the young are fledglings. It is believed that in this situation the males are more active in caring for the young after they are fledglings, making it possible for the females to concentrate on their moult.

For a number of species, the fledglings develop a very flimsy first plumage, just enough to get them out of the nest. Once away from the nest and safer from predators, the young develop a more durable immature plumage at the same time that their parents are moulting. Because the young are still under their parents' care, they do not have to cope with the task of finding enough food by themselves.

Not all birds are able to finish their moult by the time the food surplus runs out, and so some old feathers are kept. We found one buff-necked woodpecker with three years' worth of feathers on its wings; evidently the moult had been stopped twice and then continued the following year. It also appears that some Tanjung Puting birds delay their moults completely for a year if their feathers are not too worn. This surprising adaptation gives them a definite advantage over competitors forced to endure this process.

The extremely complex strategies evolved by the forest birds and bird communities of Tanjung Puting for gathering and using food efficiently shows clearly that these birds are extremely sensitive to their environment. Only when food resources are at a premium are such strategies necessary. Any change in the park environment that would modify the diversity and quantity of insects and other foods would have a direct impact on the bird population.

Yet we could not simply conclude that the prevention of any change in the food-producing habitats would assure protection for the birds. There are many other wildlife species in the park—including orangutans, proboscis monkeys, and clouded leopards—that may in the future require some changes in the environment to ensure their survival. Knowing which animals will be affected by each change is crucial to the park management plan. Their adaptation to life in this Bornean forest is based on a most fragile balance of nature.

The buff-necked woodpecker is found mostly at lower levels in the forest.

The crimson-breasted flowerpecker is a tiny bird that lives in the forest's upper canopy and feeds on insects and fruit.

The red-rumped trogan lives in the forest's mid-canopy and feeds on hard-shelled insects.

The rare Javan white-eye gleans its food from the leaves of trees in a series of short flights between the branches.

Rediscovering the Javan white-eye

Before our only confirmed sighting of the Javan white-eye, the last certain recording of this species on Borneo had taken place around the turn of the century, along the southeast coast near Banjarmasin. The Javan white-eye is one of the rarest and least known of the white-eyes, a group of small yellow-green birds with plumages that are confusingly similar.

The bird's known range is extremely limited: specimens can be found in a few localities along the north coast of western Java, but before our sighting it was only from historical records that we knew they had been found in southeastern Borneo. So when we observed a small group of white-eyes near the coastal village of Teluk Pulai, just outside Tanjung Puting National Park, we could not convince ourselves that we were seeing Javan white-eyes. The colour patterns of the birds definitely matched the description in the literature, but we could not be absolutely sure of our observation without some birds in hand. The Javan white-eye has the shortest tail of all the region's white-eyes, less than thirty-three millimetres. A tape measure could settle the identification question.

We set up several nets in areas frequented by the small groups of white-eyes, but the meticulous leaf-gleaning feeding habits of the species meant that they took only short flights between branches, and so could see the nets. The more we watched the birds, the more certain we were of their identity, and the more frustating was our long wait for some of them to stumble into a net.

Late in the day we were rewarded with three birds, including one that was not quite an adult. All three birds had tails measuring thirty-one millimetres—proof that the Javan white-eye still survives along the southern coast of Borneo.

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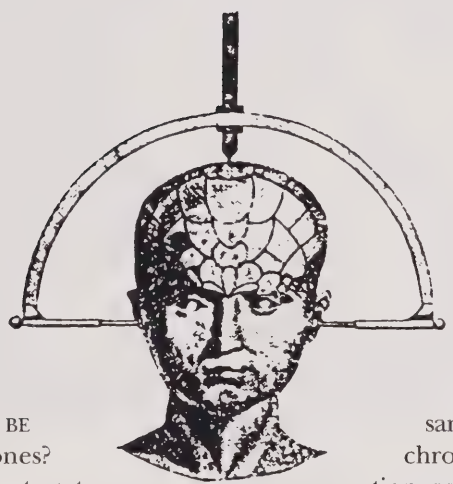
SHELLEY R. SAUNDERS



PHOTOGRAPHY AND ILLUSTRATIONS COURTESY S. SAUNDERS

WHAT SECRETS CAN BE unlocked from bones? What can be learned about past populations from little more than skeletons? Through their research, skeletal biologists, specialists within the field of physical anthropology, can show how ancient people adapted to their environments through biological and behavioural changes.

For example, conventional wisdom holds that a society's transition from hunting to agriculture as the principal means of acquiring food has been a beneficial change. But in the past decade, research conducted on early populations of the Old and New worlds is showing that the effects of plant cultivation on health and lifestyle can be drastic. In many skeletal samples there is evidence of chronic disease and malnutrition, which often occur among people who live in clustered, settled villages and who rely too heavily on a single food source. Of course, there are many populations that do find a variety of ways of adapting to difficult environments, and so in fact the agricultural revolution was neither all good nor all bad.

Interest in skeletal research began in the late 18th century, largely with measurement of the human skull. Nowadays the entire skeleton is analysed, and although visual observations and measurements made by an experienced investigator are still crucial (there's no substitute for experience when determining the sex or age-at-death of a skeleton), the work of

Shelley Saunders teaches at McMaster University and is a research associate in the Museum's Department of New World Archaeology.

Previous page: This 19th century headspanner measured the conformation of the cranium.

Most mature human bone is composed of rodlike packets of bone called osteons, shown here in cross-section. The central cavity contains blood vessels and nerves. New osteons are constantly formed as old bone tissue is replaced by new tissue. If the age, sex, and location of a bone specimen is known, the rate of turnover of bone tissue can be established by recording the density of new osteons.

skeletal biologists has been enhanced by microscopic, chemical, and biomechanical techniques.

Until recently, very young individuals found in skeletal samples were pretty much ignored. But the biocultural approach—that is, looking at the combination of biological and cultural behavioural changes—is proving that skeletons of infants and children can be particularly good indicators of the state of health and health practices of the whole population.

Infancy to early childhood is the most precarious period of life because of the nutritional requirements of the child's rapidly growing body and the body's susceptibility to disease. The greatest number of deaths always occur in the first year. On the other hand, any nutritional deficiencies or diseases that so drastically and so obviously affected the children would probably have affected the rest of the population also in varying degrees. It is also very easy to estimate the age-at-death of children, because living children provide detailed standards for the development of teeth and bones at the various stages of children's growth. Estimating the age-of-death of adult skeletons is much more difficult because active growth has stopped, and signs of physical aging do not take place at regular chronological ages.

Bone is a living and dynamic tissue that responds to metabolic disturbances during an individual's lifetime. Even after the individual's death, skeletal markers of these disturbances remain. Because these markers have been thoroughly examined in living children—some of them healthy, others malnourished—there is substantial information for the effective study of markers in archaeological skeletons.

In the past, researchers grouped their skeletal samples into relatively broad age categories, such as birth to five years. The results of their studies were too vague for detecting many important health risks. But when the age categories are narrowed (here the condition of the bones and the size of the sample are crucial) significant discoveries are made. For example, deaths of newborns in the first four weeks after birth are generally caused by obstetrical and developmental problems, while deaths that occur from one month to one year after birth—infant deaths—reflect environmental influences such as poor sanitation, poor nutrition, and deficiences in maternal care. Consequently, one would expect prehistoric societies to have had more infant than newborn deaths. Only in modern industrialized countries are there more newborn than infant deaths.

Some of the most detailed research on ancient newborn and infant skeletons has

been carried out on the remains from Egyptian farm villagers of the 6th to 15th centuries. The skeletal researchers working with these remains discovered that , of deaths in the first year, 75 per cent were in the infant rather than the newborn category.

Yet Michael Spence from the University of Western Ontario and I found newborn deaths to be much more common when we examined burials discovered in and around the longhouses of nine late prehistoric and historic Ontario Iroquois villages. Using the formation of the tooth crowns and measurements of the sizes of the developing long bones to estimate age-at-death, we were surprised to find that approximately 60 per cent of these skeletons were of newborns. However, from French documents written in the 17th century we knew that the Iroquois did not usually bury newborns in the special ossuary pits at their Feast of the Dead. Other skeletal biologists too have found that newborns are noticeably lacking from the ossuary samples they have studied. This suggests that burials of newborns in villages and longhouses involved a special practice.

Next to one of the babies in our study sample a bone awl, a clam shell, and the bones of a marten's paws were found. The burial was in a longhouse at the Benson Site, located in the Kawartha Lakes region of the Trent Valley in south-central Ontario. By adding an emotional element to childbirth practices, these objects made the burial an especially interesting one.

Gabriel Sagard, who journeyed through the region in 1621, tells of newborns having their ears pierced with a bone awl or a fish bone, being made to swallow oil (held perhaps in a clam shell), and being wrapped in furs (such as a marten skin) for the cradleboard. Obviously, the Benson infant didn't survive such a ceremony. When the Jesuits lived with the Iroquois during the 17th century, they remarked that young babies who died were buried along pathways so that their souls could re-enter the wombs of passing women. Researchers had assumed that these paths would be outside the village, but there is no reason why they couldn't have been paths or corridors found inside the longhouses. The cultural evidence supports our conclusion that the preponderance of newborn burials in villages represents a special burial practice combined with a biological phenomenon: the high mortality rate.

With good health care, child death rates fall rapidly in the second year of life to reach inconsequential levels by the fifth year. In non-industrial societies where conditions are poor, the most common cause of death during the first years of life is acute diarrhea resulting from improper feeding practices.

In addition to its nurturing and emotional value, breastfeeding also provides the best and cleanest of infant foods. The first solid foods in the baby's diet introduce two main risks, exposure to disease-causing organisms associated with contaminated foods and the possibility that the supplemental foods may be poor in nutritional value. If both of these risks are realized, then the acquired diarrheas take hold. In the 1950s and '60s, medical researchers determined that acute diarrheal attacks are most frequent and severe during and immediately after weaning. In many non-industrial societies weaning takes place between six and eighteen months of age, so that persistent high death rates in the second year of life serve as an indicator of the general health of a community. But obviously the timing and number of deaths associated with weaning could vary depending on the length of the nursing period, the initiation and the abruptness of the weaning process, and

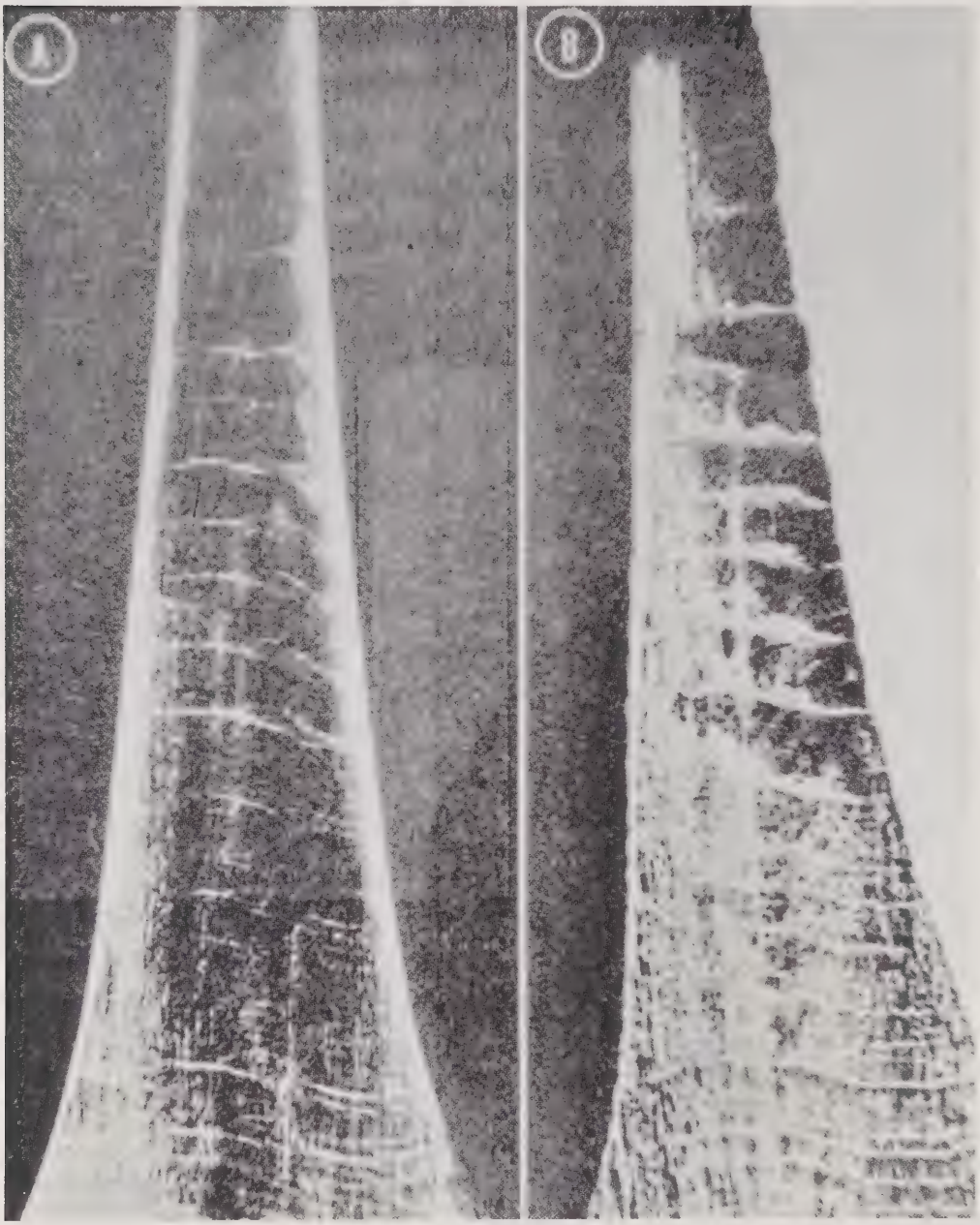
Bone is a living and dynamic tissue that responds to metabolic disturbances during an individual's lifetime. Even after the individual's death, skeletal markers of these disturbances remain. Because the markers have been thoroughly studied in the living, there is substantial information for the study of archaeological skeletons.

The Iroquois Feast of the Dead was interpreted by a European artist based on what he read in journals kept by the explorers.

Below right: The bones from disarticulated skeletons visible in the Kleinburg ossuary.

the nature and amount of supplementary foods.

Recently, Jerry Melbye, of the University of Toronto, and I analysed the infants' and children's skeletons from the Kleinburg ossuary. The site dates to A.D. 1600 and is located approximately thirty kilometres northwest of Toronto. In southern Ontario, in the late prehistoric and early historic period, we know that one or more groups of Indian villagers placed their dead in a common ossuary, or bone pit, at the Feast of the Dead. This ceremony was said to take place once every ten to thirty years when the village population was forced to move because the constant cultivation of corn had depleted the agricultural land of its nutrients and sources of firewood had been exhausted. Gradually, from about A.D. 700, corn formed an increasingly important part of the Iroquois's diet and there has always been a question as to the effects of this horticulture on their health.



Above: A longitudinal cut of a thigh bone reveals the many transverse Harris lines (see page 52) that were formed when the bone was growing. They mark periods of physical stress. B shows the cut bone, and A shows the X-ray of the bone.

Using tooth development as an indicator we were able to cast the Kleinburg skeletal sample into narrow age categories. We observed that a large proportion of the children were aged two to three years—in fact, these comprised more than 20 per cent of all the children up to the age of fifteen years. Fetuses and newborns were rare, probably because of the special burial practices. But the large number of toddlers required some explanation. There is no evidence of exceptional burial practices to favour this particular age group's inclusion in the ossuary. It seemed likely that these were children who died at or just after the weaning process, very likely from weanling diarrhea. Other skeletal biologists have found large numbers of two- to four-year-olds in their skeletal samples, which they attribute to weanling deaths associated with late nursing.

The Jesuit records tell us that the 17th-century Iroquois women nursed their children for two or three years and that couples abstained from intercourse for this period. Even though it is doubtful that such abstinence was invariably maintained, the Jesuits observed that Iroquois families were small by French standards, averaging about three children. This lower fertility rate would correspond well with the practice of prolonged nursing.

But were Ontario Indian children of

the late prehistoric and early historic period a sickly or a healthy lot? Since there seem to be such large numbers of them in our skeletal samples, it would appear that they tended to be sickly. But skeletal samples are biased samples of the dead; they represent only the individuals who succumbed to some hazard at a certain stage in their lives.

Ideally, to make assessments of the health of the general population, data are needed for all deaths over a specific time period. However, special cultural practices may have prohibited the burial of babies and some adults in the cemetery. Skeletal markers that indicate disease stress in particular age categories are the most reliable sources of information.

When Jerry Melbye and I examined bone volume and quality in the Kleinburg children's bones, we found that there was less bone tissue in the shafts of the long bones of the toddlers than in the bones of all other children. Studies of living children have shown that malnutrition and illness will inhibit growth first in bone thickness and then, if the problem continues and is severe, in bone length.

When the sample graphs of long-bone lengths and shaft cross-sectional areas for all of the infants and children were compared to those from several other populations, it was found that the Kleinburg children's bones were comparable in size and volume to those of other Indian populations of the same period, and that they were not as severely affected as the bones from the early Egyptian farming populations.

The Kleinburg adults' bones were not always of the best quality either. Another skeletal biologist, Susan Pfeiffer, has discovered that the bones of more than 20 per cent of Kleinburg adults could be diagnosed as being osteopenic, or excessively thin, compared to the bones of healthy modern Europeans. She has suggested that because of their heavy reliance on corn, the Kleinburg adults would have had low levels of calcium or excess phosphorus-to-calcium ratios, thereby compromising their bone metabolism. Although corn was their staple food, they did eat other cultivated and wild vegetables, as well as fish and meat, and so the nutritional value of their diet must have been better than that of the primarily cereal diet of the Egyptians.

The Kleinburg adult sample could not be separated by sex. However, clinical studies have shown that nursing mothers require substantial amounts of nutrients to maintain bone thickness and quality. In the Egyptian studies it was found that young adult women had excessively thin bones and this was attributed to the rigours of lactation exacerbated by poor diets.

A recent study on bone density in present-day post-menopausal women found that American Indian women have less bone mass than Caucasian women of similar age. The researchers suggested that the causes could be environmental. But is it possible that there are genetic factors influencing bone density that might place Indians at greater risk to diseases such as osteoporosis?

More information on bone quality in prehistoric and historic societies is needed, for it may shed some light on diseases in modern society. For example, is it true

American Indian women have been found to have less bone mass than Caucasian women of similar age. Researchers have suggested that the causes could be environmental. Is it possible that there are also genetic causes?

that most prehistoric Iroquoians had less bone mass than modern Europeans? Does average bone density in the Ontario Iroquois change over time and, if so, is this change influenced by the introduction of corn cultivation or by other changes such as population movements, increasing population density, and intensification of trade in the 16th century? We know that European contact dealt a devastating blow to the health of the indigenous peoples of North America, but we must also consider that a great deal was happening socially and no doubt biologically even before that fateful encounter.

In addition, some of the recent studies of early European explorers' and settlers' bones will broaden our base of compar-

Markers of health

There are a number of markers of chronic or intermittent illness that skeletal biologists can look for when examining infant, child, and adult skeletons. We can't always come up with specific diagnoses of what caused these changes in each individual skeleton but they can be used to identify risk groups and assess general levels of health.

Abnormally thin bones indicate that the processes of bone formation and removal are no longer balanced. We can investigate this problem in greater detail by comparing the microscopic structure of the ancient bone to samples from modern individuals of the same sex and age.

Enamel defects are grooves or pits visible on the surfaces of teeth. They are produced when the tooth crown is forming. A growth disturbance such as a fever or a vitamin deficiency alters or kills the enamel-forming cells leaving a distinct bandlike deformity running around the crown of the tooth. These bands remain as "records" of the metabolic events during the years of growth. A great variety of disturbances can produce enamel defects, which are common even in modern populations. By measuring the location of a defect on a tooth crown, a skeletal biologist can determine its "age of occurrence" and identify specific periods of risk during growth. The biologist can also compare the frequencies and severity of defects in different prehistoric economies.

Enamel defects are visible as discoloured linear grooves on the surfaces of the teeth of this twenty-year-old man whose skeleton comes from a southern Ontario site dating to the mid-16th century.

Harris lines are dense transverse plates of bone found in long bones and are visible in X-rays. The lines are formed while the bones are growing. At the ends of each long bone there is a plate of cartilage where growth in length takes place during infancy and childhood. Line formation occurs when growth stops at the cartilage plate and then starts again. During the period of growth recovery new bone is laid down in a transverse fashion. As the whole bone continues to grow in length, the Harris line is left as a marker of a period of stress. Thus, it's possible to detect the age of line formation. Harris lines are, however, the most difficult of skeletal markers to study. From modern clinical work we know that their formation is not always associated with a detectable illness. They can also be lost at a later time because the bone tissue continues to remodel itself throughout life. Consequently, it's important to study all of the skeletal markers together when analysing a skeleton sample.

isons. Biological investigations of skeletal material found at Fort Louisbourg in Nova Scotia, the Citadel in Quebec City, and Fort Frontenac and Fort Erie in Ontario are especially valuable because observations can be checked against historical documents. Questions will be answered as a great deal more is learned about the potential as well as the limitations of skeletal markers of disease stress in providing a link between the skeletal samples we can study today and the living, breathing humans of the past.

There are a number of other useful markers which detect stress in infants' and children's skeletons (see facing page). Enamel defects, or hypoplasias, are transverse linear depressions visible on the surfaces of teeth. They are produced only when the tooth crown is forming. Some kind of physiological disturbance alters the structure of the mineralizing enamel prisms, which are then laid down in abnormal directions. Those age groups in the sample of skeletal remains that have a disproportionate number of individuals with enamel defects should be most stressed. It is important to look for hypoplasias in both the milk and permanent teeth (the milk teeth form prenatally and up to the second year) because individuals under two years of age would have died before their permanent tooth crowns were fully formed. A study by David Patterson of the enamel hypoplasias in the Kleinburg sample found no hypoplasias in the baby teeth. The highest frequencies were in the permanent teeth of children aged two to three years. Although these results may be affected by sampling problems it still seems likely that the weanling group was at highest risk.

Although nutritional factors were important to the overall health and mortality rate of Ontario Iroquois children, it is now clear from other skeletal and archaeological work that in the late protohistoric period, population crowding, intensified trading and warfare, and the influences felt from European activities on the Atlantic coast also had their effects on the Iroquois. In the 16th and 17th centuries, the full force of European encroachment reached southern Ontario. It was the most devastating blow to the health and ultimately to the survival of the native inhabitants.

Although nutritional factors, crowding, and intensified trade and warfare affected the health of the native populations, the encroachment of the Europeans was the most devastating blow to the Indians' health and ultimately their survival.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The cobblestones of Paris

If you whiz through Paris, Ontario, in your car, you see a pleasant town sprawling along the confluence of the Grand and Nith rivers. It has the usual Canadian small-town amenities—a Chinese restaurant, several smoky cafes, one antiques shop, and a few impressive houses on Grand River Street North. But a few hours spent walking Paris's streets will bring you face to face with a decidedly unexpected conjunction of geology, history, and architecture.

In the 1840s and '50s in Paris, an American folk tradition found its only foothold in Canada West. Cobblestones from the west bank of the Grand River were combined with the grand classical allusions of Greek Revival architecture. The results of this unlikely *mélange,* in Paris and in the neighbouring township of South Dumfries, are eleven cobblestone houses and two cobblestone churches, a collection unique in Canada.

The raw materials were there for the asking, and had been since the last ice age when glaciers ground the loose stones on top of the bedrock into cobblestones. (A pebble is a stone that can be held in two fingers, while a cobblestone can be held in one hand, and a boulder demands two hands. Geologists classify a stone that measures from 64 to 256 millimetres in diameter as a cobblestone.) The rubble rounded and polished by the glaciers was mostly local sedimentary sandstone and limestone, but it included smaller amounts of harder metamorphic stones, such as gneiss and quartzite, transported by the glaciers from as far north as Labrador. When the ice melted, the cobbles remained. Some, called field cobbles, are roughly rounded; others, including the ones around Lake Ontario's shoreline and in the area around Paris, were subjected to further rounding and polishing by glacial rivers and lakes.

Around 1825, in upstate New York, the masons who had just finished building the Erie Canal noted the plentiful water-rounded stones and the local limestone, which could be crushed and burned to produce lime for mortar. They began to construct houses by laying the cobbles in horizontal courses in mortar, with a raised ridge of mortar between the courses. Some of the masons were English and may have been inspired by the 18th- and 19th-century English houses constructed of beach

PHOTOGRAPHY, C. VARLEY

Rows of stones that are equal in size make the most attractive cobblestone structures.

flints, but the exact source remains unknown. Progressing rapidly from primitive ideas of construction and style to sturdy, highly sophisticated houses, the masons produced hundreds of cobblestone buildings in western and central New York State during the 1830s and 1840s.

The vogue crossed the border to Paris (and only to Paris) in 1839, when a New York State stonemason named Levi Boughton emigrated to Canada West. This was not the town's first exposure to Americans. Paris was founded in 1831 by a Vermonter, Hiram Capron, who realized the value of the plaster beds along the river banks and named the town after them. The cheap Canadian land appealed to many Americans in the early decades of the century, and Capron was joined by other "pushing, independent, success-at-any-price" Yankees, as a local history described them. They included Norman Hamilton, who made a fortune from pigs and whiskey; Charles Mitchell, a New Yorker who owned a carriage-making factory; and Asa Wolverton, a Southerner who ran two sawmills. All four men commissioned handsome houses, but the town's distinctive architectural stamp is the work of the craftsman Levi Boughton.

Born in Albany, New York, Boughton had learned his trade in the area around Rochester. At the age of thirty-five he settled in Paris, probably because the burgeoning town with a large American population would afford plenty of work for a skilled mason. He may have greeted the great heaps of cobblestones on the Grand River's west bank with glad cries, but no sound man of business would base a move entirely on such a material. Cobblestone masonry was a labour-intensive folk art, an architectural flourish to be indulged in sparingly, and Boughton no doubt spent most of his working hours in Paris crafting houses in brick and quarried stone. But he also found the time to build Paris's most memorable houses out of cobbles, and to perfect his own skill in that demanding medium.

A successful cobblestone building gives the effect of fine needlepoint, with similarly-sized stones (or "stitches") all turned to the same diagonal and the mortar relatively unobtrusive. Levi Boughton's first commission in Paris, St. James Anglican Church at the corner of Burwell and Church streets, is not one of those successes. Unlike Boughton's later, more refined work, the cobbles are of differing sizes and textures, and they compete unhappily with fieldstone and wood, with Gothic windows, and with a complicated tower.

Some ten years later, in the 1850s, Boughton's skill had increased to the point where he could attempt a building of startling simplicity. The tightly knit rows of small, even cobblestones on the druggist Samuel Sowden's house at 5 Burwell Street offer a silent rebuke to St. James just across the street: not even the house's handsome bracketed cornice is allowed to distract the eye from the cobbles' fascinating regularity. The Sowden house's most bravura feature is a curving corner, so that the two cobblestone walls that face the street unfold in a single seamless sheet. The back-facing walls are made of fieldstone construction, which was much less time-consuming. The Victorians

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said of houses like this that they had a "Lady Anne front and a Maryann back."

If shoemakers' children go proverbially the worst shod, masons seem to find it difficult to finish their own houses. By 1851, Levi Boughton had built the town's most impressive dwellings but he and his wife and seven children were still living in a lath-and-plaster house. The census-taker for that year recorded that the Boughtons were building a house, in "what is called coble work." The finished product, at 19 Queen Street, looks as if Levi Junior, also a mason and eighteen years old in 1851, did some apprentice work on the family home. It's a pleasant enough cottage (although very small for nine people), but it lacks the finesse of Boughton's mature work: too much mortar shows and the cobbles march heedlessly in different directions.

The Boughton cottage and the Sowden house are unpretentious essays in vernacular styles. When something more grand was called for, the American entrepreneurs in Paris turned naturally to the Greek Revival style. Considering themselves the spiritual heirs of Athenian democracy, the Yankees had fallen so in love with porches, pediments, and Doric columns that in 1842 the architect Alexander Jackson Davis complained that it was impossible to distinguish churches, banks, and courthouses in a typical American town. Ironically, when the Charles Mitchells, Asa Wolvertons, and Norman Hamiltons decided to settle in stoutly monarchical Canada West, they brought with them the style that symbolized the democratic values of a young republic.

The house Levi Boughton built in the 1840s for Charles Mitchell at 16 Broadway Street indicates how well cobblestones could combine with the Greek Revival style. The nubbled effect of the cobbles softens the deep cornices, the heavy Doric columns, and the severe porch; and they in turn dignify the modest, commonplace stones set in

limestone mortar. The cobblestone work itself is perhaps Boughton's finest achievement, and the side addition, built as a doctor's office in 1885, matches so well that it may have benefited from his experienced eye. (Although Paris's masons continued to build with cobbles well into the 1860s, long after the vogue had ended in New York State, the 1885 addition is definitely a postscript.)

Paris's *pièce de résistance,* and one of Ontario's finest Greek Revival houses, Hamilton Place, was designed by Andrew Minny and completed in 1844. The owner, Norman Hamilton, who came from the Rochester area and had made a fortune in Paris from his distillery and pork-packing plant, was willing to wait for his dream house. Levi Boughton probably supervised the collection of cobbles of the right size and sheen for several years before beginning construction. The cobblestone façade was tied to the rubblestone wall behind it by every fourth or fifth cobble, which was longer and projected into the rubblestone core. The elliptical cobbles themselves, which are placed at right angles to the wall, are about 22.9 cm long, and the entire wall about 71 cm deep.

In this case, it's not the cobbles that demand your attention first; it's the striking shape of the building, rather like a deep-crowned hat perched on massive Doric pillars. When you walk up to inspect the pillars (each one of which encases an enormous log to support the roof), you see the familiar, neat rows of cobblestones under the deep veranda.

Of course, Paris has every other variety of 19th-century housing, from workers' cottages to Second Empire mansions, but so do many Canadian towns of its vintage. It is its cobblestone monuments, from Hamilton Place to the humblest fence or smokehouse, that commemorate a unique moment in Canadian domestic architecture.

KATHERINE ASHENBURG

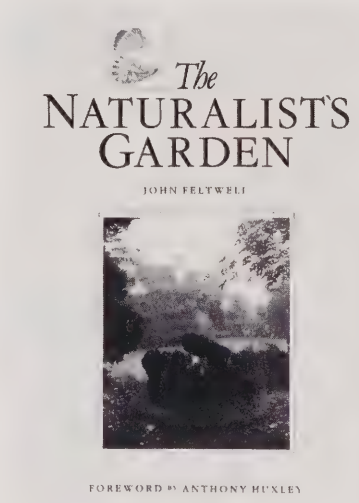
The Naturalist's Garden

The Naturalist's Garden
John Feltwell
McGraw-Hill Ryerson Limited
160 pp. $24.95 (cloth)

GARDENERS WHO LIKE TO LET their private territory take its own way will find this handsomely illustrated book both a treat and a tease: a treat because the author offers compelling reasons for cherishing wilderness, even in the smallest urban yard; a tease because much specific information is referred to rather than given, leaving readers to search out the answers on their own. But perhaps that's not such a bad thing. In these days of "instant everything," having to pause and reflect could be the change that's as good as a rest.

Dr. John Feltwell is a Fellow of the Royal Entomological Society and the Linnaean Society, and a Member of the Royal Photographic Society and the Institute of Biology, as well as the prolific author of more than 70 books and scientific papers. With all this, he still finds time to tend an East Sussex garden that he refers to, with affectionate pride, as "an unattractive jungle of plants left to their own devices," and then proceeds to describe it so charmingly that one longs to tear out neat beds and tidy borders straightaway. To Dr. Feltwell, the naturalist's garden is a place where native plants flourish alongside compatible introductions, and where wildlife of all kinds is actively encouraged and observed.

While *The Naturalist's Garden* has a predominantly British focus, the rest of the world is by no means neglected. Beginning with the plantings of ancient Persia, Greece, and Rome, Dr. Feltwell moves confidently across continents and through the centuries, trailing fascinating information as he goes. We learn that infertile soils show a greater rate of seed germination than fertile ones, that concern about pollution is as



old as Pliny the Elder, that redwoods have fireproof bark (handy, as they're often decapitated by lightning), and that the longer any tree is established as a native, the more insects will be associated with it. (On his home ground, he cites the English oak, which may harbour more than 300 species of insects, while the monkey puzzle tree, introduced from Chile in the last century, holds few if any.)

There are intriguing and amusing glances at some of the famous figures associated with gardening. Charles Darwin, for instance, had his grandchildren hide themselves in a hedgerow to hunt for bumblebees, while Winston Churchill had such a passion for butterflies that he hoped the National Trust (which was to care for his country home after his death) would keep plenty of plants like lavender to entice them.

Despite this book's many attractions, a few errors have crept in. At one point, 350,000 litres of olive oil is said to equal 77 gallons. At another, Thomas Jefferson is mentioned as minister to Paris from 1744 to 1789...which would make him quite a precocious tot, since he was born in 1743. (The actual dates are 1784 to 1789.) Another mild irritation is caused by the two-page sections on special subjects—excellent in themselves—that are dropped into the text. Does the reader skip on to follow the interrupted text, and perhaps forget to come back, or read the insert and risk losing the main thread? The last nuisance is that while many books are mentioned throughout *The Naturalist's Garden* they're not drawn together into a bibliography. Take notes as you go along to avoid exasperating searches for a title later.

Quibbles aside, this is a valuable book: a lively introduction for the novice, and a source of new tidbits and insights for the more experienced gardener. Dr. Feltwell himself provides the best summing up. "By creating and maintaining an imaginative diversity, we can establish truly 'living' gardens that will be enjoyed by benefactors (the gardeners) and beneficiaries (the inhabitants) alike."

Reviewed by GLORIA VARLEY,
a Toronto-based food and garden writer

Ford's new extended-length Aerostar. Now, even longer on looks and space.

A new Aerostar model—with 792L (28 cu. ft.) more cargo space in back!

A new extended-length Aerostar now joins Ford's regular-length mini-van—the one that sets high standards for aerodynamic design, luxury and versatility. With the same wheelbase, both Aerostars are easy to handle and park.

First class comfort.

Aerostar's luxurious and well-appointed interior can now carry 7 people—or 4643L (164 cu. ft.) of cargo—501L (17.7 cu. ft.) more than Chrysler. Choose sporty XL or XLT or stylish Eddie Bauer.

V-6 power, standard!

Aerostar's electronic fuel-injected V6 delivers 145 horsepower, 45 more than Chrysler's standard 2.5L 4-cylinder. Now more than ever, Aerostar goes to new lengths to be the best.

Ford

A Literary Temper Tantrum?

It is unfortunate but correct that *Rotunda* does not solicit letters to the editor. In such circumstances, it behooves the editors to scrupulously review material so that it conforms with the academic, cultural, and information policies of the ROM.

You must have been away on vacation when a recent article ("MOMI: A Tough Act to Focus", Volume 21, no.2) by Noah Richler, a freelance author and BBC radio commentator, was accepted without deletions. The official publication of the ROM should not contain the literary temper tantrums of a disgruntled left-wing media person.

In future please stick to policy and avoid politics.

GERALD D. HART, M.D.
TORONTO

Dinosaurs and Kangaroos

In the Fall 1988 issue of *Rotunda* (Volume 21, no. 2), one feature covered dinosaurs. It was then that I noticed a similarity in appearance between some dinosaurs and kangaroos. Could there be any connection?

C. H. SIMPSON
KELOWNA B.C.

According to the ROM's Department of Vertebrate Palaeontology there is no connection; the kangaroo is a marsupial and is therefore unrelated to dinosaurs, which were reptiles. Ed.

Dinosaurs and Deception

I am delighted with your magazine. The lending of my copies to friends has lead to two more subscriptions. The dinosaur feature in the Fall issue (Volume 21, no. 2) was of particular interest to me, and the article, *Threads of Deception,* in the same issue, was of great interest to the new subscribers because they are weavers.

IRENE F. RODGER
SALMON ARM, B.C.

Baking Time

While as always enjoying *Rotunda,* the Winter 1988/89 issue (Vol. 21, no.3) contains an article by Gloria Varley entitled "The Story of Dough" that appears to have a peculiar inaccuracy in it.

In describing the process of producing loaves of bread at Weston's the writer states that "From start to finish, the process takes about eight hours—just as it would at home."

Over the last sixteen years my wife has baked bread twice a week, even including the two years we spent in West Africa. This is for our own home use, and takes her between two and three hours "from start to finish." Since, unlike the unfortunate Egyptian girl pictured in the article, she does not have to grind the grain, nor culture the yeast, I am baffled why my wife would have to take eight hours for this simple process. It might be worth noting also that the majority of the two or three hours is spent waiting for the dough to rise and in baking the loaves.

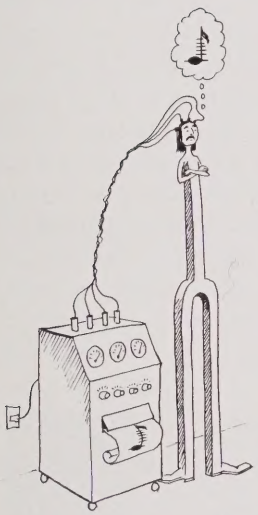
Apart from the flour, yeast, and water, the only other ingredients she uses are small amounts of salt and sugar. The result is always a tasty product, which costs about 10 per cent of the store-bought price.

WESLEY R. PORTER
TORONTO

Letters are edited and may be condensed. Mail correspondence to Rotunda *magazine, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario, M5S 2C6.*

JAY INGRAM

Here's the pitch



1. One of the longest-running experiments in the world was set up to examine one of the obvious attributes of pitch, the black tarry substance. What is the experiment, and why is it taking so long?

2. Studies of the electrical patterns in music students' brains revealed that some who possess a certain rare musical faculty have different brain waves from their colleagues. These differences appeared even when the students heard only single musical notes. What is the rare ability that some of these students have?

3. A baseball can be pitched to make it curve in a variety of directions, and usually the greater the speed and the greater the spin, the more pronounced the curve. But there is one pitch in baseball that is most effective when it rotates no more than a one-quarter turn on the way to the plate. What is it?

4. The pitcher plant is a carnivorous plant that feeds on insects that fall into its inverted-bell-like flower, then drown. But this is not accidental, the pitcher plant lures its prey. How?

5. While the pitch of someone's voice can send a non-verbal message, there is one particular human interaction in which the pitch of the voice might even be the whole message. What situation is that?

THE ANSWERS

1. The experiment is designed to illustrate how long it takes pitch to drip. It's set up in the physics building at the University of Queensland in Brisbane, Australia. The pitch is in a funnel that is enclosed in a bell jar. The tarry liquid forms a drop shaped much like the drop of water from the end of a faucet. However, pitch is extremely resistant to flow. This experiment has been running since 1930, and in that time one drop has formed and fallen every eight years and one month. But no one has ever seen it.

John Mainstone, a physicist at the university, while at his office one Saturday in 1979, noted that the drop was hanging by a thin neck, and returned to work Monday only to see that it had fallen. Last summer, the same unfortunate scenario unfolded. The experiment had been moved to the World's Fair site in Brisbane, and on 3 July around 4:25 p.m., a technician noted that it was just about ready to go. But ready in this case could be a day, so he left. Sure enough, the drop fell, and nobody saw it. Worse still, the drop is estimated to have fallen around 4:45 p.m., a mere twenty minutes later.

2. Perfect pitch. That, of course, is the ability to name a note, or to identify a pitch, without needing to hear other notes or pitches for comparison. In this particular experiment, music students heard a rapid series of two slightly different tones, one of which appeared five times as often as the other. They were asked to count the number of times they heard the rarer tone, while at the same time their brain waves were monitored. The brains of those students without perfect

pitch showed signs of busily trying to compare all the tones recently heard in order to identify those rare ones. But apparently students with perfect pitch don't have to bother comparing all the tones they can remember. They claim to know immediately whether the tone they just heard was the same or different, and the brain wave recordings bear them out—there's no evidence of any remembering, comparing, or updating going on.

3. The knuckleball. It's effective when the curve is unpredictable, and that is the case when the ball is turning very slowly. The explanation is easier to visualize if you think of the air moving past the ball, rather than the ball moving through the air. Air moving past the ball stays in contact with the surface until about halfway around, then it breaks away. This happens smoothly until the slow rotation of the knuckleball moves the ball's stitches right into that place where the air is leaving the ball's surface. There is a sudden jolt as the point of separation of the passing air stream flips from one side of the stitching to the other. That flip is enough to cause the ball to break sharply—and unpredictably—in one direction or another.

4. Pitcher plants go to great lengths to ensure a steady diet of insect protein. They're usually lined with nectar-producing glands that trail invitingly around the outside of the pitcher leading to the mouth, and these glands are also concentrated just inside the lip of the pitcher, encouraging that last fateful step just over the edge. Of course, once inside the footing gets treacherous: there are both smooth waxy surfaces on which footholds are difficult to establish, and downward-pointing hairs that allow entry but not exit. But the most devilish adaptation is an area of translucent tissue part way down the side of the pitcher called a "fenestration." This allows welcoming daylight for insects that might otherwise hesitate to enter a dark funnel. In some cases it misleads flying insects into taking off and heading for what they assume is an open hole, only to strike the side of the pitcher and fall into the soup of digestive enzymes below. (Of course, none of this explains why small frogs and even a mouse have been found dead in pitcher plants.)

5. Mothers talking to their newborns. Mothers raise the pitch of their voices when trying to attract their baby's attention, and move it up and down when they're trying to hold an infant's gaze or smile. The period when their babies are from two to six months old is when mothers most often exaggerate the pitch of their voices, and it's shortly after that that babies can distinguish melodies. Some psychologists think that learning to distinguish pitch, and then melodies, are steps towards language development.

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